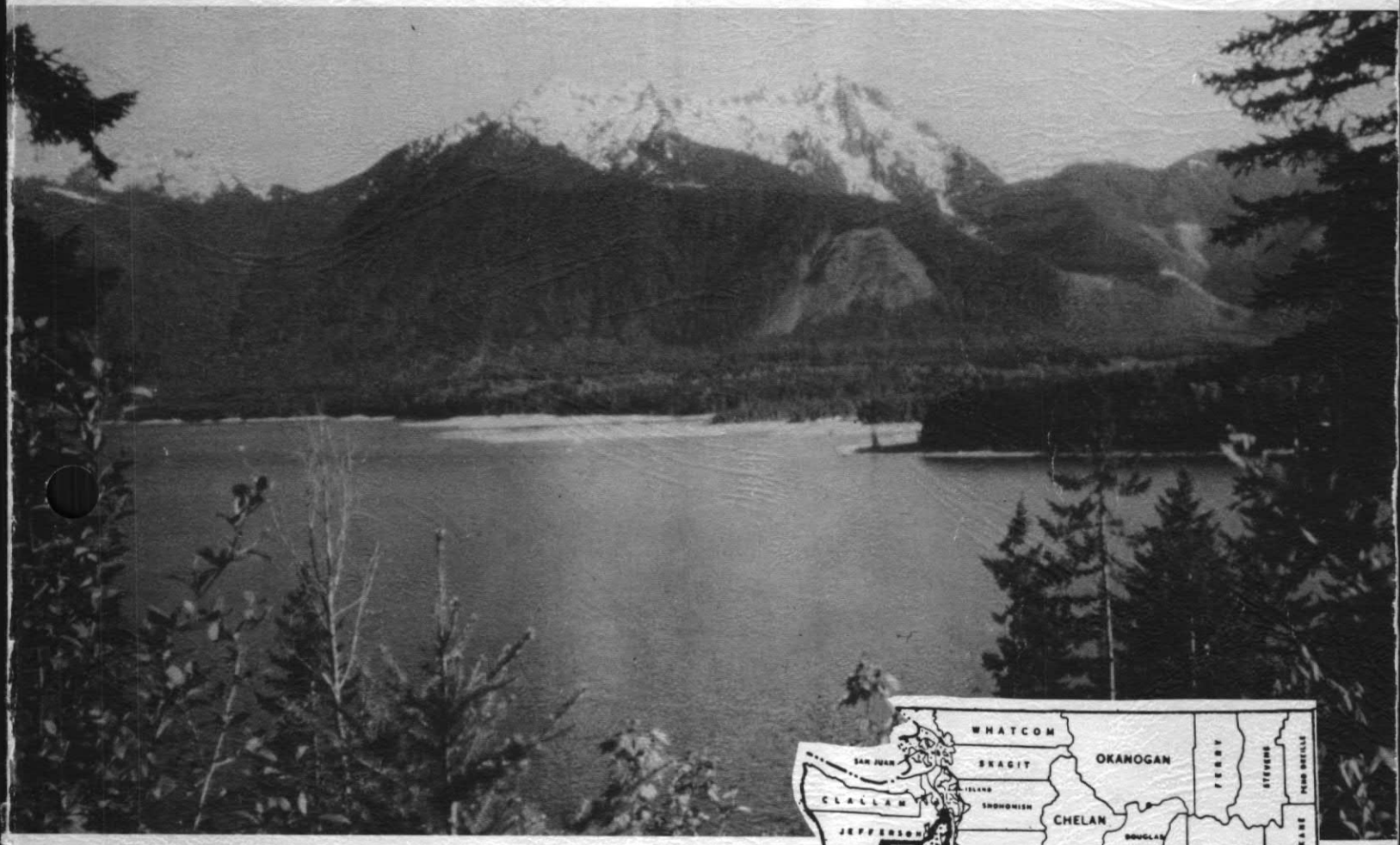
# RECONNAISSANCE DATA ON LAKES IN WASHINGTON VOLUME 3

## KITSAP, MASON, AND PIERCE COUNTIES




STATE OF WASHINGTON
DANIEL J. EVANS, Governor

DEPARTMENT OF ECOLOGY
JOHN A. BIGGS, Director

Water-Supply Bulletin 43, Vol. 3

Prepared in Cooperation with
United States Department of the Interior
Geological Survey • 1976

STATE OF WASHINGTON
Daniel J. Evans, Governor

DEPARTMENT OF ECOLOGY
John A. Biggs, Director

---

Water-Supply Bulletin 43, Vol. 3

# RECONNAISSANCE DATA ON LAKES IN WASHINGTON

## VOLUME 3

## KITSAP, MASON, AND PIERCE COUNTIES

By

G. C. Bortleson, N. P. Dion, J. B. McConnell,
and L. M. Nelson

Prepared in cooperation with

UNITED STATES GEOLOGICAL SURVEY

1976

CONTENTS



ILLUSTRATION

The following factors are provided for conversion of English values used in this report to metric values:

| Multiply | By | To obtain |
|---|---|---|
| Inches | 2.54 | centimetres (cm) |
| Feet (ft) | .3048 | metres (m) |
| Miles (mi) | 1.609 | kilometres (km) |
| Cubic feet ($ft^3$) | .02832 | cubic metres ($m^3$) |
| Square miles (sq mi) | 2.590 | square kilometres ($km^2$) |
| Acres | 4047. | square metres ($m^2$) |
| | .4047 | hectares (ha) |
| Cubic feet per second ($ft^3/s$) | .02832 | cubic metres per second ($m^3/s$) |

# RECONNAISSANCE DATA ON LAKES IN WASHINGTON
# VOLUME 3

## KITSAP, MASON, AND PIERCE COUNTIES

By G. C. Bortleson, N. P. Dion, J. B. McConnell,
and L. M. Nelson

## ABSTRACT

A total of 91 lakes in three counties of western Washington was sampled using helicopter or boat to obtain information on their physical, cultural, and water-quality conditions. The basic data presented will be useful to planning groups involved in lake management and to sportsmen, tourists, and others interested in Washington's lakes.

## INTRODUCTION

The State of Washington has more than 7,800 lakes, ponds, and reservoirs (Wolcott, 1964 and 1965), many of which provide excellent recreational opportunities and supply water for agricultural, municipal, and industrial purposes. These water bodies constitute an important part of the State's total water resources and are an integral part of the hydrology of many drainage basins.

This is the third of a seven-volume series of reports on Washington lakes and contains data from 91 lakes in Kitsap, Mason, and Pierce Counties in the western part of the State (fig. 1).

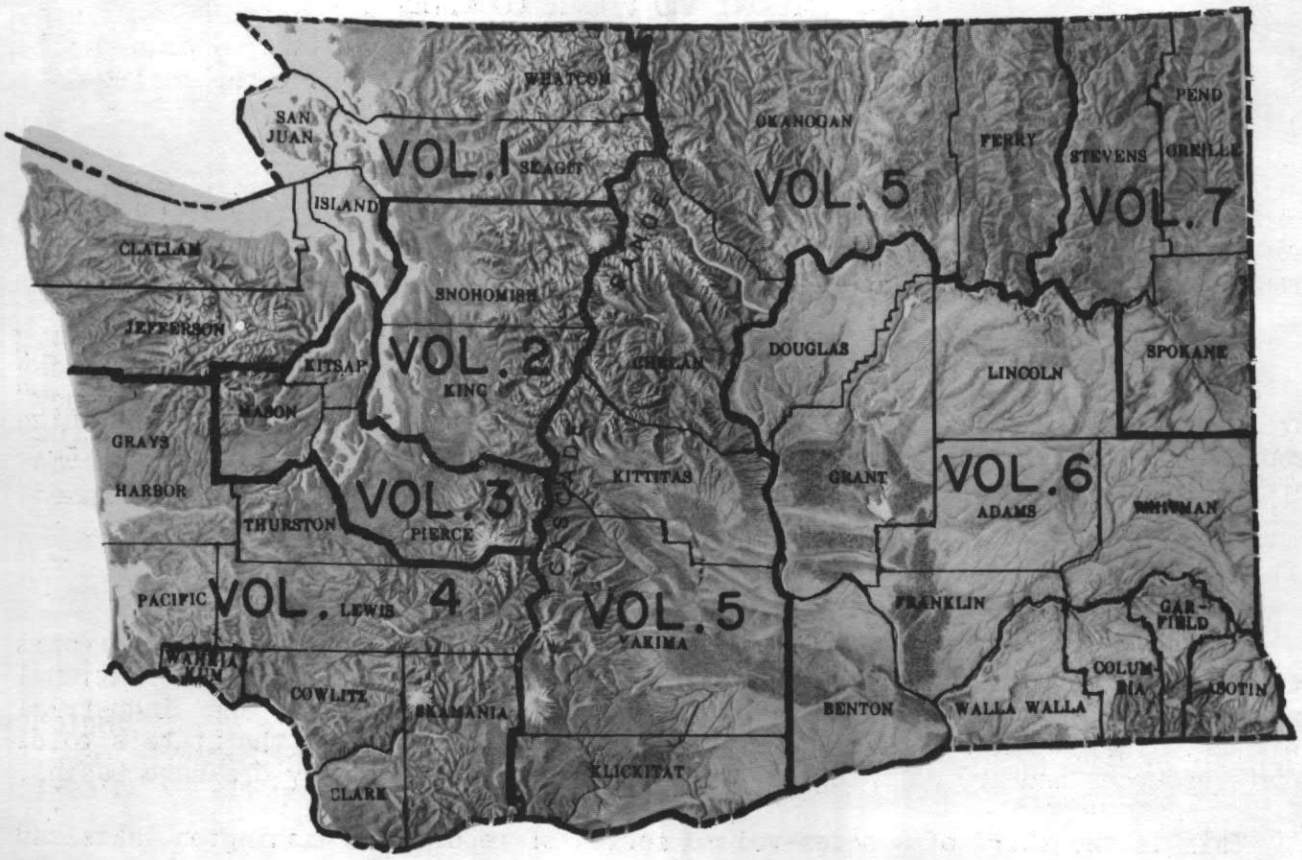



FIGURE 1.--Location of counties covered in each of seven-volume report series.

## Purpose and Scope

Although both the importance and value of the Washington lakes are widely recognized, the quantity and types of information currently available for most of the lakes are not adequate to provide the understanding needed for wise management of the lakes. Thus, the need to obtain additional information about lakes resulted in the initiation in 1970 of a cooperative program between the Washington State Department of Ecology and the U.S. Geological Survey, whereby selected lakes in Washington would be investigated (Collings, 1973; Bortleson and others, 1974). Because the program--designed for the study of approximately 25 lakes per year during fiscal years 1970-74--deals with only a small fraction of the total number of lakes in the State, a reconnaissance study involving several hundred lakes was undertaken to provide preliminary information for use by planning groups as well as sportsmen, tourists, and others interested in preserving the water quality of Washington's lakes.

In general, the study consists of a data-collection program designed to (1) document the present water quality and the overall status of the lakes, and (2) provide basic data pertaining to the physical, cultural, and water- quality characteristics of the lakes.

More than 750 lakes in all but four counties of the State were studied; these are equally distributed between western and eastern Washington. Most of the lakes investigated were 20 acres or larger in size and were selected because they constitute shorelines of the State covered under the Shoreline Management Act of 1971 (Washington State Department of Ecology, 1973). However, some of the lakes listed as constituting shorelines of the State were not sampled; these included marshes with no open water or intermittent lakes which were dry at the time of visit.

## Acknowledgments

The authors gratefully acknowledge the assistance of the State of Washington Department of Game for permission to reproduce many of the lake bathymetric maps. Many other bathymetric maps were reproduced from those in the reports by Wolcott (1964, 1965).

## Occurrence of Lakes in Washington

Lakes in Washington occur under various geologic conditions. In the Puget Sound Lowland of western Washington most lakes occupy depressions in the surface of glacial drift--the sand, gravel, silt, clay, and till laid down by the Puget lobe of continental glaciers during the ice age. These depressions are either elongate troughs cut by the passing ice sheet or are more circular kettles formed by the melting of stagnant ice blocks.

In the adjacent foothills of the Cascade Range and Olympic Mountains, most lakes occupy depressions eroded into the bedrock by the passing continental glacier, while lakes in the higher mountains are in basins cut by local alpine glaciers.

In eastern Washington, lakes in the higher northern areas--the Okanogan Highlands and Selkirk Mountains--and on the eastern slope of the Cascade Range generally occur in glacier-cut depressions in bedrock. In the semiarid Columbia Plateau, underlain by basalt, most lakes occupy the more deeply cut parts of some coulees of the channeled scablands. Most of these coulees were cut by gigantic, catastrophic floods (Bretz, 1959) resulting from the breaking of ice dams and the rapid emptying of large glacial lakes.

Many lakes have been formed, or increased in size, by man's activities. Numerous reservoirs are located in mountain valleys and serve a variety of purposes, including municipal water supply, irrigation, electrical-power generation, flood control, and recreation. In lowland areas some natural lakes have been enlarged or new lakes have been formed by small dams. In the Columbia Basin Irrigation Project area of eastern Washington, several lakes have been enlarged and reservoirs (Banks Lake and Potholes Reservoir) have been created in conjunction with large-scale irrigation by water diverted from the Columbia River at Grand Coulee Dam. Also, numerous small lakes and ponds have resulted from irrigation in the area.

## Data Collected and Definitions

The data collected and the lake parameters used in describing the individual lakes are explained here, prior to presentation of the data for each lake. The parameters are discussed in the sequence in which they appear on the data sheets. The definitions of additional limnological and hydrological terms used throughout the report are found in the Glossary (p. 10).

Lake name. The lake name was taken from U.S. Geological Survey topographic maps. Duplicate lake names are followed by location designations for uniqueness. Lakes that are not named on the topographic map and for which no local name is known are referred to as "unnamed," followed by a location designation. Only the proper name of the lake is given; in common usage the term "Lake" may either precede or follow the proper name. All adjectives (for example, Big, East, and Upper) follow the lake name. When a lake has two names, both are given, but priority is given to the topographic-map name. The lake names and respective data are listed alphabetically by counties.

Location. Latitude, longitude, township, range, and section location were determined from U.S. Geological Survey quadrangle maps. The location point is the lake outlet. For lakes without outlets, the southernmost shoreline point is used. The lakes are presented in the report according to the county in which the location point occurs.

Drainage basin. The major drainage system in which the lake is located was determined. Some lakes drain directly into Puget Sound or the Pacific Ocean without entering a major river system.

Physical data. Physical parameters were determined from topographic and bathymetric (bottom-contour) maps of the lakes. If bathymetric maps were not available, the lakes were sounded and charted by boat using a continuous-recording fathometer. For lakes with no boat access, a helicopter equipped with a fathometer, pontoons, and a conventional outboard motor was used to chart the lake. By use of aerial photographs and lake depths, the bathymetric data were digitized and transferred to computer cards which served as input to a computerized program that calculated lake morphometric parameters (for example, lake volume, surface area, and length of shoreline).

Drainage area.--The surface-drainage area, that contributes water to the lake is given in square miles (sq mi). These areas were delineated on U.S. Geological Survey topographic maps and measured by planimeter. Some lakes are in drainage basins of low relief in which surface runoff to the lake may not be a significant factor. Nevertheless, in all cases the drainage area was determined according to topographic divide.

Surface altitude.--A single altitude in feet (ft) above mean sea level (msl), obtained from topographic maps, is given for each lake. If not specifically shown on the map, altitudes are estimated from the nearest contour line. The altitude of a reservoir is given as the level of the water surface at normal full reservoir capacity.

Surface area (A).--The surface area of the lake, in acres, was obtained from planimetry of the lake outline or from computerized calculations of digitized data.

Volume (V).--Lake volume, in acre-feet, was obtained either by computing and then summing the volumes of each stratum of water between successive contours on the bathymetric map or by calculating from digitized data. Because lake volume can vary between seasons and from year to year, the volume figures reported (as well as other morphometric data) are intended only to describe the general size of the lake.

Mean depth ($\bar{Z}$).--The mean depth, in feet, for a specified lake stage, was obtained by dividing the volume of the lake by its area.

Maximum depth ($Z_m$).--The difference in elevation, in feet, between the bottom and the surface of the lake. The maximum depth obtained from field surveys may not necessarily be shown on the bathymetric maps.

Length of shoreline (L).--The distance around, or perimeter, in miles, of the water surface touching the shore at a specified lake stage. The shoreline length depends on the fineness of detail of the shore outline on the bathymetric map.

Shoreline configuration ($D_L$).--A dimensionless ratio of the length of shoreline to the circumference of a circle having an area equal to that of the lake, given as

$$D_L = \frac{L}{2\sqrt{\pi A}} .$$

This quantity may be regarded as an index of the geological and littoral processes affecting the shape of the lake. Nearly circular lakes have values near unity, subcircular lakes have slightly greater $D_L$ values and elongate lakes have the highest $D_L$ values. High $D_L$ values are common to lakes formed along old drainages or by the damming of streams to form a lake in the valley behind a dam.

High values for shoreline configuration suggest the presence of shallow water and protected bays--areas suitable for plant growth--and also indicate an increase in contact between land and water. Therefore, shoreline configuration is often an indirect indicator of plant growth capacity and enrichment potential from nearshore development and runoff.

Development of volume ($D_V$).--The development of volume is defined as the ratio of the mean depth ($\bar{Z}$) to the maximum depth ($Z_m$). Thus, lakes with a low $D_V$ ratio are usually conical-shaped depressions, and lakes with a high $D_V$ ratio are steep-sided with flat bottoms. Shallow lakes which have large values for development of volume ($D_V$), tend to provide the greater opportunity for exposure of bottom sediments to overlying water and for circulation of bottom nutrients.

Bottom slope ($Z_r$).--The slope profile of a lake bottom, expressed as a percentage ratio of the maximum depth to the mean lake diameter (referred to by Hutchinson, 1957, p. 167, as relative depth) and given as

$$Z_r = \frac{Z_m \times 50\sqrt{\pi}}{\sqrt{A}} .$$

Bottom slope is a measure of the extent of shallow water and is important to the growth of rooted aquatic plants and potential for wind mixing of water with bottom sediments.

Basin geology. The predominant geology of the lake's drainage basin was obtained from a geologic map of the State of Washington (Huntting and others, 1961). The drainage basin is indicated as being underlain by either (1) unconsolidated sedimentary deposits and (or) metasedimentary rocks, or (2) igneous rocks.

Inflow. Perennial or intermittent surface inflow is indicated, if known. Some lakes have no visible inflow, and water gain is from direct precipitation on the lake and (or) from ground-water seepage.

Outflow. The presence or absence of a surface-water outflow channel is indicated. Some lakes have no surface-water outflow, and water loss is through evaporation, transpiration, and (or) ground-water seepage.

Cultural data. Data related to cultural development were obtained from topographic maps, aerial photographs, and shoreline reconnaissance by helicopter or boat.

Nearshore residential development.--The percentage of shoreline occupied by residential development was determined from aerial photographs.

Number of nearshore homes.--A count of the number of nearshore homes adjoining the lakefront was made from field observations, topographic maps, or aerial photographs.

Land use.--The drainage basins of the lakes were partitioned into various generalized land-use categories. Values given reflect the percentages of the basin used primarily for forest or for residential urban, residential suburban, or agricultural development. The lake surface is also given as a percentage of the total drainage basin. A general description of the land-use categories is as follows:

a. Residential urban.--Predominant use is for single-family residences, where apartment complexes and commercial or industrial activities also may be present.

b. Residential suburban.--Predominant use is single-family residences.

c. Agricultural.--Pasture or cropland.

d. Forest or unproductive.--Public and private forest lands and tree farms. Lands may include cleared or fallow unproductive land, meadows, wetlands, and seasonal recreational areas.

e. Lake surface.--Includes surface area of the lake and of upstream tributary lakes.

Public boat access to lake.--The presence of a public boat access is indicated. Most public boat access facilities are maintained by the State of Washington Department of Game. The location of the boat access (symbol ▲ ) is shown on the bathymetric map.

Water-quality data. From helicopters fitted with pontoons or from boats, vertical profiles of temperature and DO (dissolved oxygen) concentration were measured in the deepest part of each lake. Multiple sites were sampled on lakes with areas greater than 1,000 acres and on irregular-shaped lakes. Secchi-disc visibility was also determined. Water samples were collected for color, nutrient, and specific-conductance analyses at depths 3.0 feet below the water surface and 3-5 feet above the lake bottom. Lakes less than 5 feet deep were sampled at about one-third and two-thirds the depth of the lake. For most lakes, estimates of the percentage of both lake area and lake shoreline covered by emersed and (or) floating rooted aquatic plants were made by a visual inspection of the lake during aerial reconnaissance. Samples for fecal-coliform bacteria were collected at selected nearshore sites, approximately 100 feet offshore at a depth of 1 foot below the water surface.

Information from most of the lakes was collected during the periods of July-September 1973 or May-September 1974. Prior to 1973, some of the lakes were sampled four times during a year by Bortleson, Higgins, and Hill (1974). For those lakes sampled more than once during a year, the data from the midsummer sample period are presented. All samples were collected and analyzed according to accepted standardized procedures (American Public Health Association and others, 1971; Brown and others, 1970; and Slack and others, 1973).

Nutrients.--A nutrient is any chemical element, ion, or compound that is required by an organism for the continuation of growth, reproduction, and other life processes. Many elements and compounds act as nutrients to supply the food for aquatic plants and algae. However, nitrogen and phosphorus usually are considered the limiting nutrients to plant growth and as such received the most emphasis in this study. Whatever nutrient is limiting aquatic plant growth, the concentrations of nitrogen and phosphorus are useful in evaluating the trophic conditions of a lake (Lee, 1970). The nutrient concentrations that were determined at top and bottom sampling depths included total nitrate, nitrite, ammonia and organic nitrogen, phosphorus, and orthophosphate. For those lakes sampled during previous studies (Bortleson and others, 1974), the samples for orthophosphate, nitrite, and nitrate were filtered through a 0.45-μm (micrometre) millipore filter. The concentrations of these particular samples are indicated as "dissolved."

Specific conductance.--Specific conductance is a measure of the water's ability to conduct an electric current and is expressed in micromhos per centimetre at 25°C (Celsius). Because the specific conductance is related to the number and specific chemical types of ions in solution, it can be used for approximating the dissolved-solids concentration in the water.

Water temperature.--Temperature, which varies in lakes with depth and time of year, is an important controlling factor for life processes and chemical-reaction rates, as well as many physical events that occur in the aquatic environment.

For most lakes, the water temperatures listed for the upper, near-surface water were probably close to the maximum for the year when sampled. Temperature profiles in lakes during midsummer, when thermal stratification is marked, generally follow one of two common patterns. In shallow lakes, well exposed to the wind, temperatures will be found to be practically constant from top to bottom. This uniformity of temperature indicates that the waters are well mixed throughout. The other common pattern occurs in deeper lakes, where three characteristic thermal layers are present: (1) an upper zone (epilimnion) of generally warmer water in which temperature is more or less uniform throughout; (2) an intermediate zone (metalimnion) in which temperature decreases rapidly with depth; and (3) a lower zone (hypolimnion) of colder water in which temperature is again more or less uniform throughout.

The temperature of the deep-water layer (hypolimnion) during midsummer is of biological significance because (1) temperature stratification and water circulation affect the vertical distribution of nutrients, and (2) water temperatures affect the potential of cold-water fisheries resources.

Color.--Color is one control of light transmission through water. High color values often result from the decomposition of vegetation, giving the water a brown, tea-like color and reducing water clarity. Color value is determined by a comparison of the water with standardized colored-glass discs and is reported in platinum-cobalt (Pt-Co) units.

Secchi-disc visibility.--Secchi-disc visibility is the depth at which a black and white disc (8 inches in diameter) disappears from view when lowered into the water. Secchi-disc visibility is a measure of water transparency or clarity. Because changes in biological production can cause changes in the color and turbidity of a lake, Secchi-disc visibility often is used as a gross measure of the quantity of plankton in the water. Secchi-disc depths preceded by the symbol ">" indicate the disc was resting on the bottom of the lake and was still visible.

Dissolved oxygen.--The concentration of DO in a lake varies with time of year and depth of water and is a function of many factors, including the water temperature, atmospheric pressure, and salinity of the water. Oxygen concentration in water is continually being altered by life processes, such as photosynthesis and respiration, and by complex chemical reactions. Of special biological significance is the amount of DO in the hypolimnion during midsummer. The organisms in the lighted upper layers of water produce organic matter which eventually settles to the bottom where bacteria consume oxygen to degrade the organic materials, thereby reducing the DO concentration in the hypolimnion. The hypolimnetic-oxygen deficit frequently is related to the biomass or plant growth in the upper waters (Hutchinson, 1957). For good growth and general health of trout, salmon, and other species of cold-water biota, the DO concentrations should not be less than 6.0 mg/l (milligrams per litre) according to the Federal Water Pollution Control Administration (1968).

Emersed plants.--These are large plants that can be seen without magnification. Examples of emersed plants include cattails and sedges in which the leaves or other structures extend above the water surface. In this report, rooted floating aquatic plants such as waterlilies and watershield are considered emersed. The rooted aquatic-plant growth was assessed according to the percentage of the lakeshore and water surface covered by emersed and (or) floating plants.

Remarks. This includes other useful lake information that was obtained during the reconnaissance. Such topics as the following might be included.

1. Descriptive information.
2. Qualifying statements.
3. Availability of additional information.
4. Unusual lake or drainage-basin characteristics.

Bathymetric maps. For most of the lakes, a bathymetric map is given. The map source and date of the survey are indicated.

Aerial photographs. An aerial photograph is shown for most of the lakes and reservoirs. Black-and-white aerial photographs at an approximate scale of 1:12,000 and 1:63,000 were obtained from the State of Washington Department of Natural Resources. Additional aerial photographs at an approximate scale of 1:4,800 were taken by the U.S. Geological Survey of selected lakes in the populated, 10-county Puget Sound area and of other selected lakes throughout the State. Many of the bathymetric maps produced by the U.S. Geological Survey are shown superimposed on the aerial photographs.

## GLOSSARY

Acre-foot. Volume of water required to cover 1 acre to a depth of 1 foot, and equal to 43,560 $ft^3$ (325,851 gallons).

Algae. Simple plants, many microscopic; contain chlorophyll and lack roots, stems, and leaves. Most algae are aquatic and may become a nuisance when environmental conditions are suitable for prolific growth.

Algal bloom. A large number of a particular algal species. A condition when water looks green because of the abundance of planktonic algae.

Bathymetric. Relating to the measurement of water depths, as for a lake.

Cultural eutrophication. The acceleration of the natural process of nutrient enrichment in a lake as a result of man's activities.

Emersed plant. These are large plants that can be seen without magnification. Examples of emersed plants include cattails and sedges in which the leaves or other structures extend above the water surface. In this report, rooted floating aquatic plants such as waterlilies and watershield are considered emersed.

Eutrophication, eutrophic. The enrichment of water, a natural process that may be accelerated by the activities of man; pertains to waters in which primary productivity is generally high as a consequence of a large supply of available nutrients.

Hydrogen sulfide. A gas with a distinctive "rotten egg" odor which can be detected in the hypolimnetic water containing only a few tenths of a milligram per litre of sulfide.

Intermittent or seasonal stream. Flows at certain times of the year when it receives water from springs or from some surface source, such as melting snow in mountainous areas.

Littoral. The shoreward region of a body of water.

Macrophyte. Large plants that can be seen without magnification; includes mosses and seed plants.

Marsh. Periodically wet or continually flooded areas where the surface is not deeply submerged, covered dominantly with sedges, cattails, rushes, or other plants that require marshy conditions for their growth.

Morphometry. Definition of physical shape and size, as of a water body.

Muck. A mixture containing highly decomposed organic material in which the original plant parts are not recognizable. Contains more mineral matter, and is usually darker, than peat.

Plankton. Suspended organisms that drift with the water currents.

Production. The total amount of living matter produced in an area per unit time regardless of the fate of the living matter.

Submersed plant. A rooted aquatic plant that lives and completes its life cycle entirely below the surface of the water. Examples of submersed plants include water milfoil, pondweed, and elodea.

Thermal stratification. The layering of water masses owing to different densities in response to temperature.

## REFERENCES CITED

American Public Health Association and others, 1971, Standard methods for the examination of water and wastewater [13th ed.]: New York, Am. Public Health Assoc., Inc., 874 p.

Bortleson, G. C., Higgins, G. T., and Hill, G. W., 1974, Data on selected lakes in Washington, part 2: Washington Dept. Ecology Water-Supply Bull. 42, 145 p.

Bretz, J H., 1959, Washington's channeled scabland: Washington Div. Mines and Geology Bull. 45, 57 p.

Brown, Eugene, Skougstag, M. W., and Fishman, M. J., 1970, Methods for collection and analysis of water samples for dissolved minerals and gases: U.S. Geol. Survey Water-Resources Inv. Techniques, book 5, ch. A1, 160 p.

Collings, M. R., 1973, Data on selected lakes in Washington, part I: U.S. Geol. Survey open-file report, 179 p.

Federal Water Pollution Control Administration, 1968, Water quality criteria: Report of the National Technical Advisory Committee to the Secretary of the Interior: Federal Water Pollution Control Admin., 234 p.

Huntting, M. T., Bennett, W. A. G., Livingston, V. E., Jr, and Moen, W. S., 1961, Geologic map of Washington: Washington Div. Mines and Geology, single sheet.

Hutchinson, G. E., 1957, A treatise on limnology, v. 1, Geography, physics, and chemistry: New York, John Wiley & Sons, Inc., 1015 p.

Lee, G. F., 1970, Eutrophication: Univ. Wisconsin Water Resources Center, Occasional Paper No. 2, 39 p.

Slack, K. V., Averett, R. C., Greeson, P. E., and Lipscomb, R. G., 1973, Methods for collection and analysis of aquatic biological and microbiological samples: U.S. Geol. Survey Water-Resources Inv. Techniques, book 5, ch. A4, 165 p.

Washington Department of Ecology, 1973, Lakes constituting shorelines of the State Shoreline Management Act of 1971: Washington Administrative Code, ch. 173-20, 27 p.

Wolcott, E. E., 1964, Lakes of Washington, vol. 2, Eastern Washington: Washington Div. Water Resources Water Supply Bull. 14, 650 p.

-----1965, Lakes of Washington, vol. 1, Western Washington [2d ed.]: Washington Div. Water Resources Water Supply Bull. 14, 619 p.

# B A S I C  D A T A

HORSESHOE LAKE KITSAP COUNTY

LATITUDE 47*24'20" LONGITUDE 122*39'48" T22N-R1E-10
PUGET SOUND BASIN

| PHYSICAL DATA | | CULTURAL DATA | |
|---|---|---|---|
| DRAINAGE AREA | 0.48 SQ MI | RESIDENTIAL DEVELOPMENT | 75 % |
| ALTITUDE | 270. FT | | |
| LAKE AREA | 40. ACRES | NUMBER OF NEARSHORE HOMES | 38 |
| LAKE VOLUME | 470. ACRE-FT | | |
| MEAN DEPTH | 12. FT | LAND USE IN DRAINAGE BASIN | |
| MAXIMUM DEPTH | 20. FT | | |
| SHORELINE LENGTH | 1.3 MI | RESIDENTIAL URBAN | 0 % |
| SHORELINE CONFIGURATION | 1.4 | RESIDENTIAL SUBURBAN | 5 % |
| DEVELOPMENT OF VOLUME | 0.60 | AGRICULTURAL | 4 % |
| BOTTOM SLOPE | 1.3 % | FOREST OR UNPRODUCTIVE | 78 % |
| BASIN GEOLOGY | SED./META. | LAKE SURFACE | 13 % |
| INFLOW | NONE VISIBLE | | |
| OUTFLOW CHANNEL | PRESENT | PUBLIC BOAT ACCESS TO LAKE | YES |

WATER-QUALITY DATA (IN MG/L UNLESS OTHERWISE INDICATED)

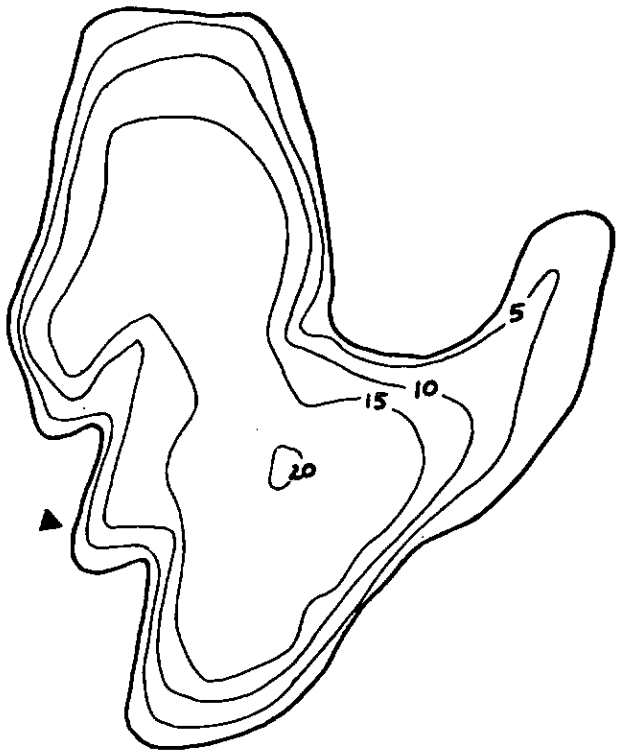
| SAMPLE SITE | 1 | |
|---|---|---|
| DATE | 6/20/73 | |
| TIME | 1325 | 1335 |
| DEPTH (FT) | 3. | 15. |
| TOTAL NITRATE (N) | 0.00 | 0.01 |
| TOTAL NITRITE (N) | 0.00 | 0.00 |
| TOTAL AMMONIA (N) | 0.04 | 0.06 |
| TOTAL ORGANIC NITROGEN (N) | 0.08 | 0.11 |
| TOTAL PHOSPHORUS (P) | 0.007 | 0.005 |
| DISSOLVED ORTHOPHOSPHATE (P) | 0.001 | 0.002 |
| SPECIFIC CONDUCTANCE (MICROMHOS) | 20 | 20 |
| WATER TEMPERATURE (DEG C) | 19.2 | 17.5 |
| COLOR (PLATINUM-COBALT UNITS) | 5 | 5 |
| SECCHI-DISC VISIBILITY (FT) | 16 | |
| DISSOLVED OXYGEN | 8.7 | 8.5 |

| | |
|---|---|
| LAKE SHORELINE COVERED BY EMERSED PLANTS | 26- 50 % |
| LAKE SURFACE COVERED BY EMERSED PLANTS | 11- 25 % |

| | |
|---|---|
| DATE | 6/20/73 |
| TIME | 1350 |
| NUMBER OF FECAL COLIFORM SAMPLES | 3 |
| FECAL COLIFORM, MINIMUM (COL./100ML) | 2 |
| FECAL COLIFORM, MAXIMUM (COL./100ML) | 18 |
| FECAL COLIFORM, MEAN (COL./100ML) | 16 |

REMARKS

A CHURCH CAMP AND COUNTY PARK ARE LOCATED ON THE LAKE. DURING THE SUMMER THE LAKE RECEIVES HEAVY RECREATIONAL USE. DENSE BEDS OF EMERSED PLANTS WERE OBSERVED IN THE SHALLOW BAYS OF THE LAKE. THE U.S. GEOLOGICAL SURVEY SAMPLED THE LAKE FOUR TIMES IN 1973. THE PLANT SURVEY WAS MADE ON AUGUST 14, 1973.




N

0 500 1000 FEET

EXPLANATION

— 10 —

Line of equal
water depth
Interval 5 feet

Horseshoe Lake, Kitsap County. From Washington Department of Game, June 21, 1949.


Horseshoe Lake, Kitsap County. July 30, 1973. Approx. scale 1:4800.

ISLAND LAKE KITSAP COUNTY

LATITUDE 47*40'42" LONGITUDE 122*39'33" T25N-R1E-10
PUGET SOUND BASIN

| PHYSICAL DATA | | CULTURAL DATA | |
|---|---|---|---|
| DRAINAGE AREA | 0.71 SQ MI | RESIDENTIAL DEVELOPMENT | 42 % |
| ALTITUDE | 217. FT | | |
| LAKE AREA | 47. ACRES | NUMBER OF NEARSHORE HOMES | 25 |
| LAKE VOLUME | 800. ACRE-FT | | |
| MEAN DEPTH | 17. FT | LAND USE IN DRAINAGE BASIN | |
| MAXIMUM DEPTH | 35. FT | | |
| SHORELINE LENGTH | 1.5 MI | RESIDENTIAL URBAN | 0 % |
| SHORELINE CONFIGURATION | 1.5 | RESIDENTIAL SUBURBAN | 4 % |
| DEVELOPMENT OF VOLUME | 0.49 | AGRICULTURAL | 8 % |
| BOTTOM SLOPE | 8.6 % | FOREST OR UNPRODUCTIVE | 78 % |
| BASIN GEOLOGY | SED./META. | LAKE SURFACE | 10 % |
| INFLOW | INTERMITTENT | | |
| OUTFLOW CHANNEL | PRESENT | PUBLIC BOAT ACCESS TO LAKE | YES |

WATER-QUALITY DATA (IN MG/L UNLESS OTHERWISE INDICATED)

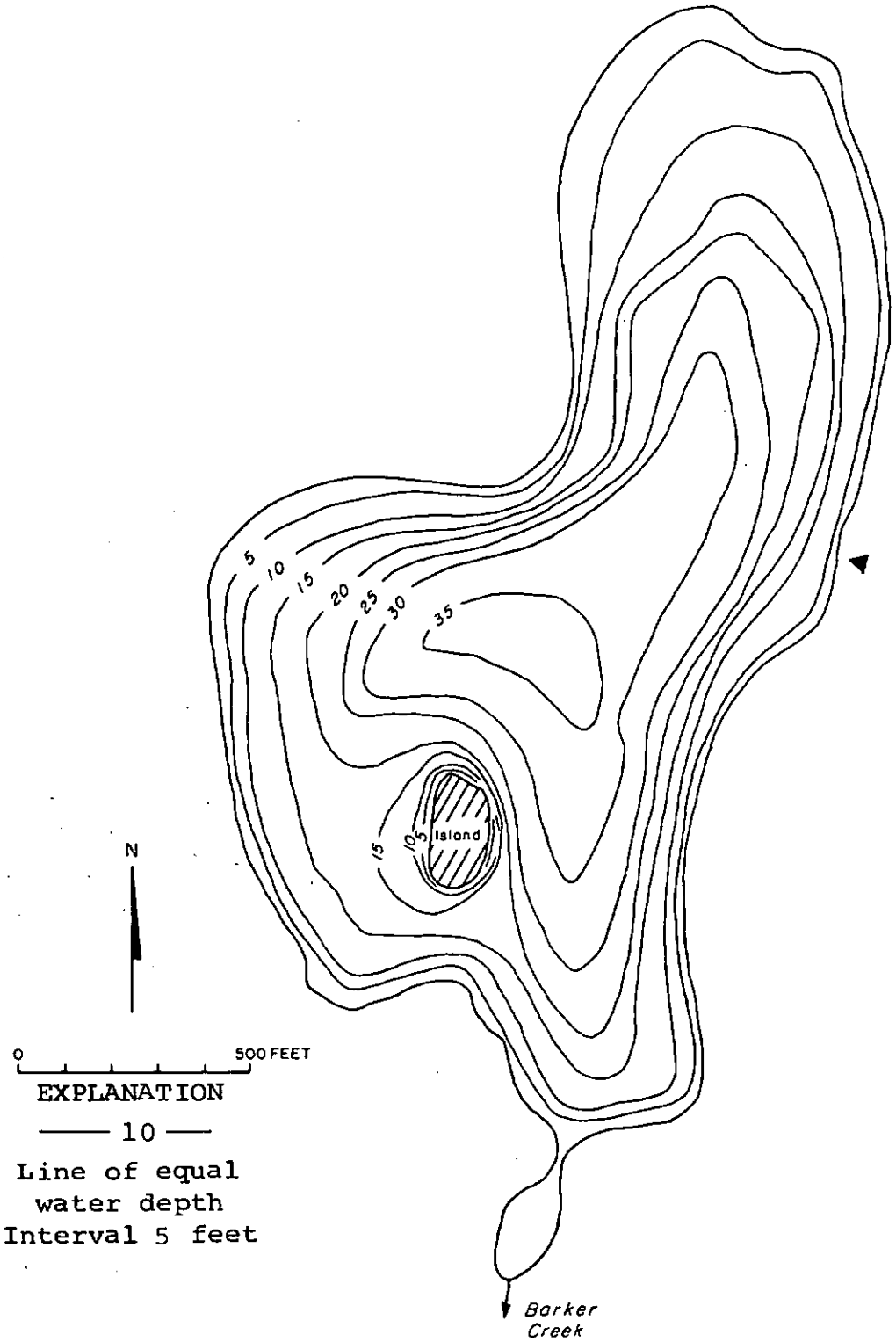
| SAMPLE SITE | 1 | |
|---|---|---|
| DATE | 8/12/71 | |
| TIME | 1115 | 1125 |
| DEPTH (FT) | 3. | 20. |
| DISSOLVED NITRATE (N) | 0.05 | 0.02 |
| TOTAL NITRITE (N) | -- | -- |
| TOTAL AMMONIA (N) | 0.07 | 0.07 |
| TOTAL ORGANIC NITROGEN (N) | 0.06 | 0.02 |
| TOTAL PHOSPHORUS (P) | 0.020 | 0.030 |
| DISSOLVED ORTHOPHOSPHATE (P) | 0.010 | 0.010 |
| SPECIFIC CONDUCTANCE (MICROMHOS) | 41 | 46 |
| WATER TEMPERATURE (DEG C) | 25.0 | 12.0 |
| COLOR (PLATINUM-COBALT UNITS) | 15 | 25 |
| SECCHI-DISC VISIBILITY (FT) | 10 | |
| DISSOLVED OXYGEN | 8.0 | 0.2 |

| | |
|---|---|
| LAKE SHORELINE COVERED BY EMERSED PLANTS | 51- 75 % |
| LAKE SURFACE COVERED BY EMERSED PLANTS | 1- 10 % |

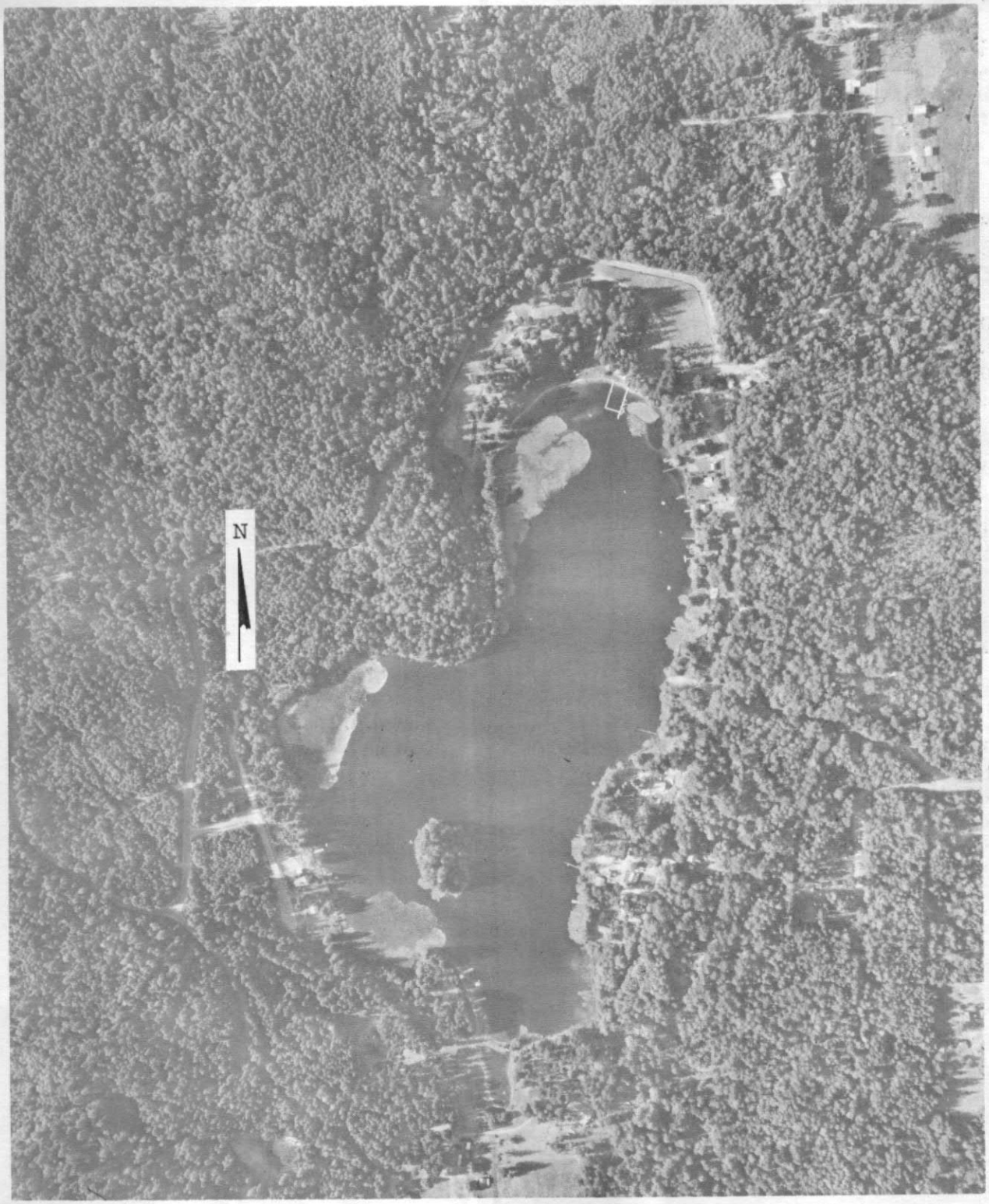
| | |
|---|---|
| DATE | 8/24/74 |
| TIME | 1035 |
| NUMBER OF FECAL COLIFORM SAMPLES | 3 |
| FECAL COLIFORM, MINIMUM (COL./100ML) | 7 |
| FECAL COLIFORM, MAXIMUM (COL./100ML) | 24 |
| FECAL COLIFORM, MEAN (COL./100ML) | 14 |

REMARKS

THE LAKE HAS A CHURCH CAMP AT THE SOUTH END AND A RESORT AT THE NORTH END. DURING THE SUMMER THE LAKE RECEIVES HEAVY RECREATIONAL USE. THE LITTORAL ZONE OF THE LAKE IS PREDOMINANTLY MUCK. IN 1971 THE U.S. GEOLOGICAL SURVEY SAMPLED THE LAKE SIX TIMES. THE PLANT SURVEY WAS MADE ON SEPTEMBER 8, 1971.




Island Lake, Kitsap County. From Washington Department of Game, July 19, 1955.




Island Lake, Kitsap County. August 9, 1972. Approx. scale 1:6600.

KITSAP LAKE KITSAP COUNTY

LATITUDE 47°34'47" LONGITUDE 122°42'34" T24N-R1W-32
PUGET SOUND BASIN

| PHYSICAL DATA | | CULTURAL DATA | |
|---|---|---|---|
| DRAINAGE AREA | 2.73 SQ MI | RESIDENTIAL DEVELOPMENT | 70 % |
| ALTITUDE | 156. FT | | |
| LAKE AREA | 250. ACRES | NUMBER OF NEARSHORE HOMES | 90 |
| LAKE VOLUME | 4500. ACRE-FT | | |
| MEAN DEPTH | 18. FT | LAND USE IN DRAINAGE BASIN | |
| MAXIMUM DEPTH | 29. FT | | |
| SHORELINE LENGTH | 2.7 MI | RESIDENTIAL URBAN | 0 % |
| SHORELINE CONFIGURATION | 1.2 | RESIDENTIAL SUBURBAN | 12 % |
| DEVELOPMENT OF VOLUME | 0.62 | AGRICULTURAL | 3 % |
| BOTTOM SLOPE | 2.7 % | FOREST OR UNPRODUCTIVE | 71 % |
| BASIN GEOLOGY | SED./META. | LAKE SURFACE | 14 % |
| INFLOW | INTERMITTENT | | |
| OUTFLOW CHANNEL | PRESENT | PUBLIC BOAT ACCESS TO LAKE | YES |

WATER-QUALITY DATA (IN MG/L UNLESS OTHERWISE INDICATED)

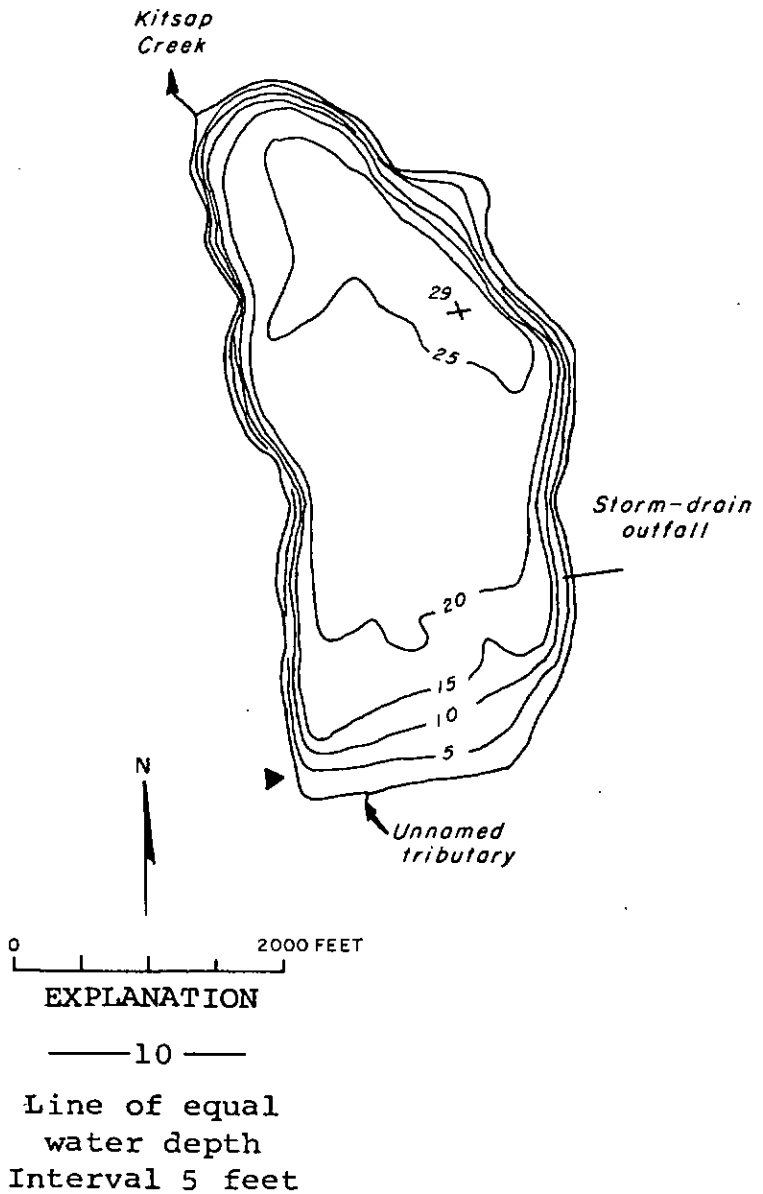
| SAMPLE SITE | 1 | |
|---|---|---|
| DATE | 6/30/71 | |
| TIME | 0 | -- |
| DEPTH (FT) | 3. | 23. |
| DISSOLVED NITRATE (N) | 0.02 | 0.02 |
| DISSOLVED NITRITE (N) | 0.00 | 0.00 |
| TOTAL AMMONIA (N) | 0.38 | 0.09 |
| TOTAL ORGANIC NITROGEN (N) | 0.06 | 0.00 |
| TOTAL PHOSPHORUS (P) | 0.020 | 0.010 |
| DISSOLVED ORTHOPHOSPHATE (P) | 0.010 | 0.010 |
| SPECIFIC CONDUCTANCE (MICROMHOS) | 81 | 82 |
| WATER TEMPERATURE (DEG C) | 18.5 | 16.9 |
| COLOR (PLATINUM-COBALT UNITS) | -- | -- |
| SECCHI-DISC VISIBILITY (FT) | 7 | |
| DISSOLVED OXYGEN | 10.5 | 8.9 |

| | |
|---|---|
| LAKE SHORELINE COVERED BY EMERSED PLANTS | 51- 75 % |
| LAKE SURFACE COVERED BY EMERSED PLANTS | 1- 10 % |

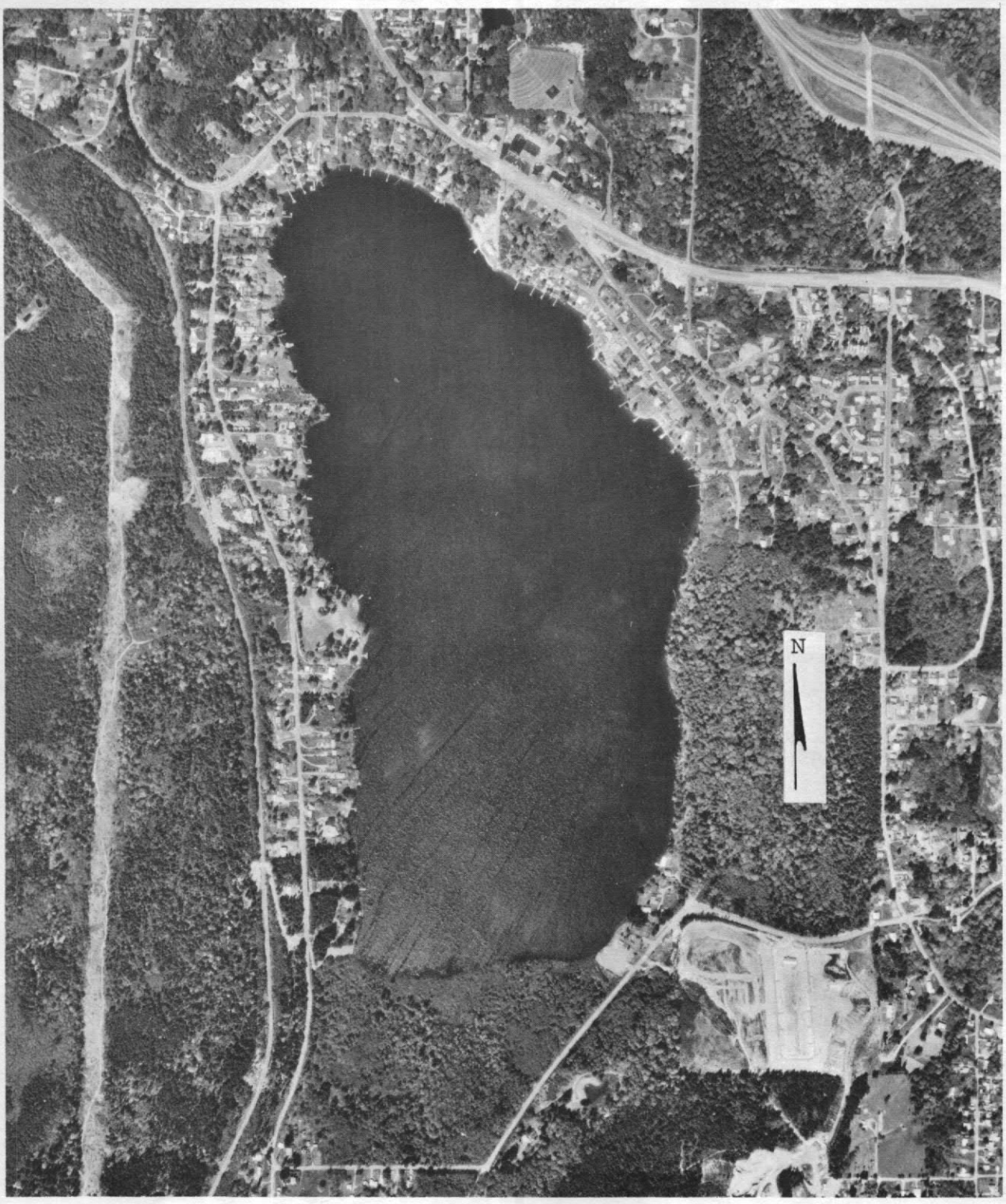
| | |
|---|---|
| DATE | 9/ 5/74 |
| TIME | 1600 |
| NUMBER OF FECAL COLIFORM SAMPLES | 4 |
| FECAL COLIFORM, MINIMUM (COL./100ML) | 3 |
| FECAL COLIFORM, MAXIMUM (COL./100ML) | 27 |
| FECAL COLIFORM, MEAN (COL./100ML) | 10 |

REMARKS

AN URBAN LAKE LOCATED NEAR BREMERTON. THE WATER LEVEL IS STABILIZED BY A FIVE-FOOT DAM. MOST OF THE SHORELINE WAS COVERED WITH EMERSED PLANTS (LILIES, SEDGES, AND CATTAILS). THE WATERLILY GROWTH WAS GREATEST IN THE SHALLOW SOUTHERN END OF THE LAKE WHERE PATCHES EXISTED 300 TO 500 FEET FROM SHORE. THE LITTORAL BOTTOM IS MOSTLY MUCK. AN ALGAL BLOOM WAS OBSERVED. THE U.S. GEOLOGICAL SURVEY SAMPLED THE LAKE FOUR TIMES IN 1971. THE PLANT SURVEY WAS MADE ON SEPTEMBER 8, 1971.




Kitsap Lake, Kitsap County. From Washington Department of Game, June 7, 1950.




Kitsap Lake, Kitsap County. May 4, 1972. Approx. scale 1:12,000.

LONG LAKE KITSAP COUNTY

LATITUDE 47*28'58" LONGITUDE 122*35'12" T23N-R2E-17
PUGET SOUND BASIN

| PHYSICAL DATA | | CULTURAL DATA | |
|---|---|---|---|
| DRAINAGE AREA | 9.36 SQ MI | RESIDENTIAL DEVELOPMENT | 67 % |
| ALTITUDE | 516. FT | | |
| LAKE AREA | 340. ACRES | NUMBER OF NEARSHORE HOMES | 121 |
| LAKE VOLUME | 2200. ACRE-FT | | |
| MEAN DEPTH | 6. FT | LAND USE IN DRAINAGE BASIN | |
| MAXIMUM DEPTH | 12. FT | | |
| SHORELINE LENGTH | 5.1 MI | RESIDENTIAL URBAN | 0 % |
| SHORELINE CONFIGURATION | 2.0 | RESIDENTIAL SUBURBAN | 5 % |
| DEVELOPMENT OF VOLUME | 0.54 | AGRICULTURAL | 20 % |
| BOTTOM SLOPE | 0.28 % | FOREST OR UNPRODUCTIVE | 69 % |
| BASIN GEOLOGY | IGNEOUS | LAKE SURFACE | 6 % |
| INFLOW | PERENNIAL | | |
| OUTFLOW CHANNEL | PRESENT | PUBLIC BOAT ACCESS TO LAKE | YES |

WATER-QUALITY DATA (IN MG/L UNLESS OTHERWISE INDICATED)

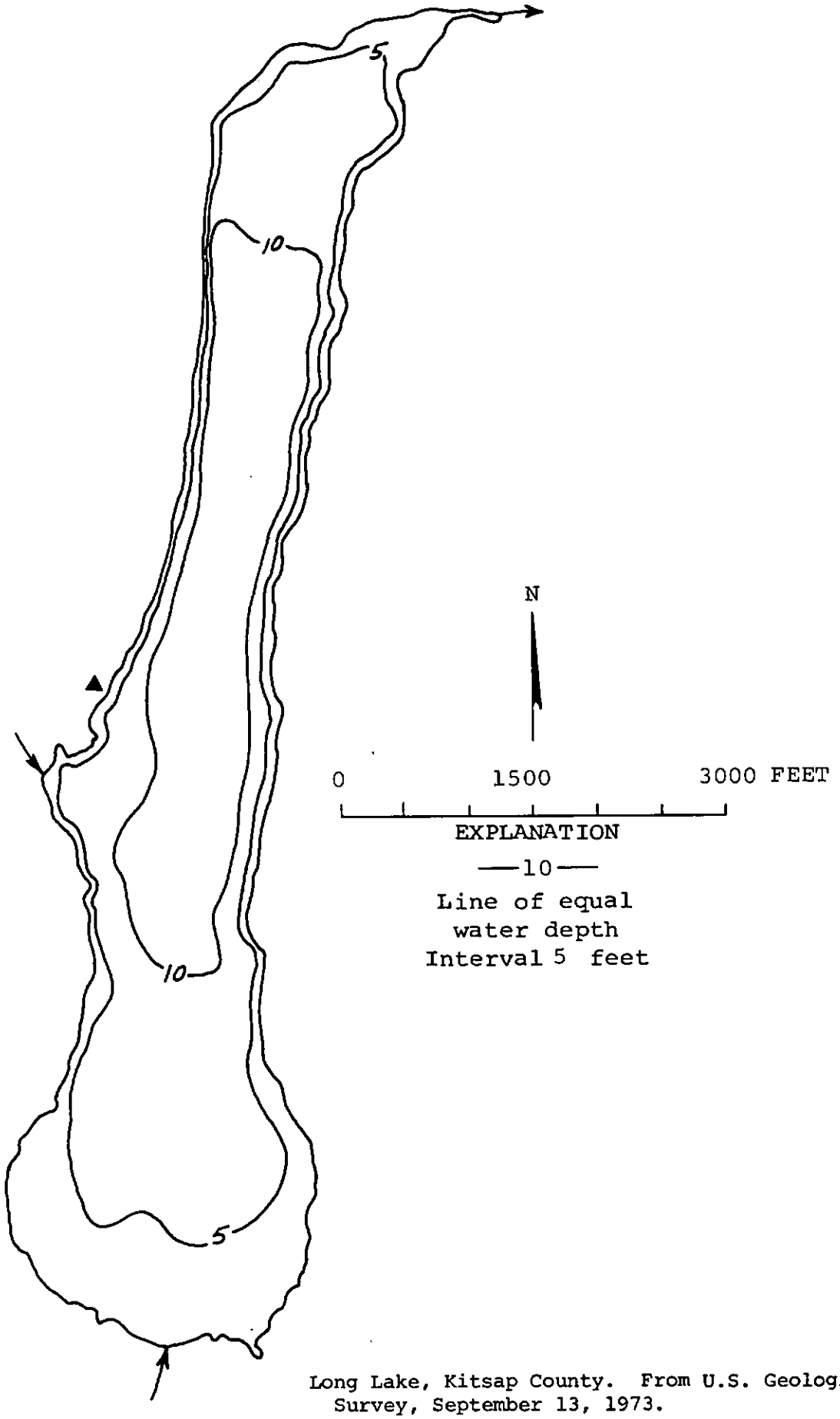
| SAMPLE SITE | 1 | |
|---|---|---|
| DATE | 6/22/73 | |
| TIME | 1040 | 1045 |
| DEPTH (FT) | 3. | 7. |
| TOTAL NITRATE (N) | 0.01 | 0.02 |
| TOTAL NITRITE (N) | 0.00 | 0.00 |
| TOTAL AMMONIA (N) | 0.41 | 0.40 |
| TOTAL ORGANIC NITROGEN (N) | 0.09 | 0.07 |
| TOTAL PHOSPHORUS (P) | 0.041 | 0.022 |
| DISSOLVED ORTHOPHOSPHATE (P) | 0.005 | 0.005 |
| SPECIFIC CONDUCTANCE (MICROMHOS) | 74 | 74 |
| WATER TEMPERATURE (DEG C) | 21.0 | 18.3 |
| COLOR (PLATINUM-COBALT UNITS) | 30 | 30 |
| SECCHI-DISC VISIBILITY (FT) | 5 | |
| DISSOLVED OXYGEN | 12.0 | 9.4 |

| | |
|---|---|
| LAKE SHORELINE COVERED BY EMERSED PLANTS | 26- 50 % |
| LAKE SURFACE COVERED BY EMERSED PLANTS | 1- 10 % |

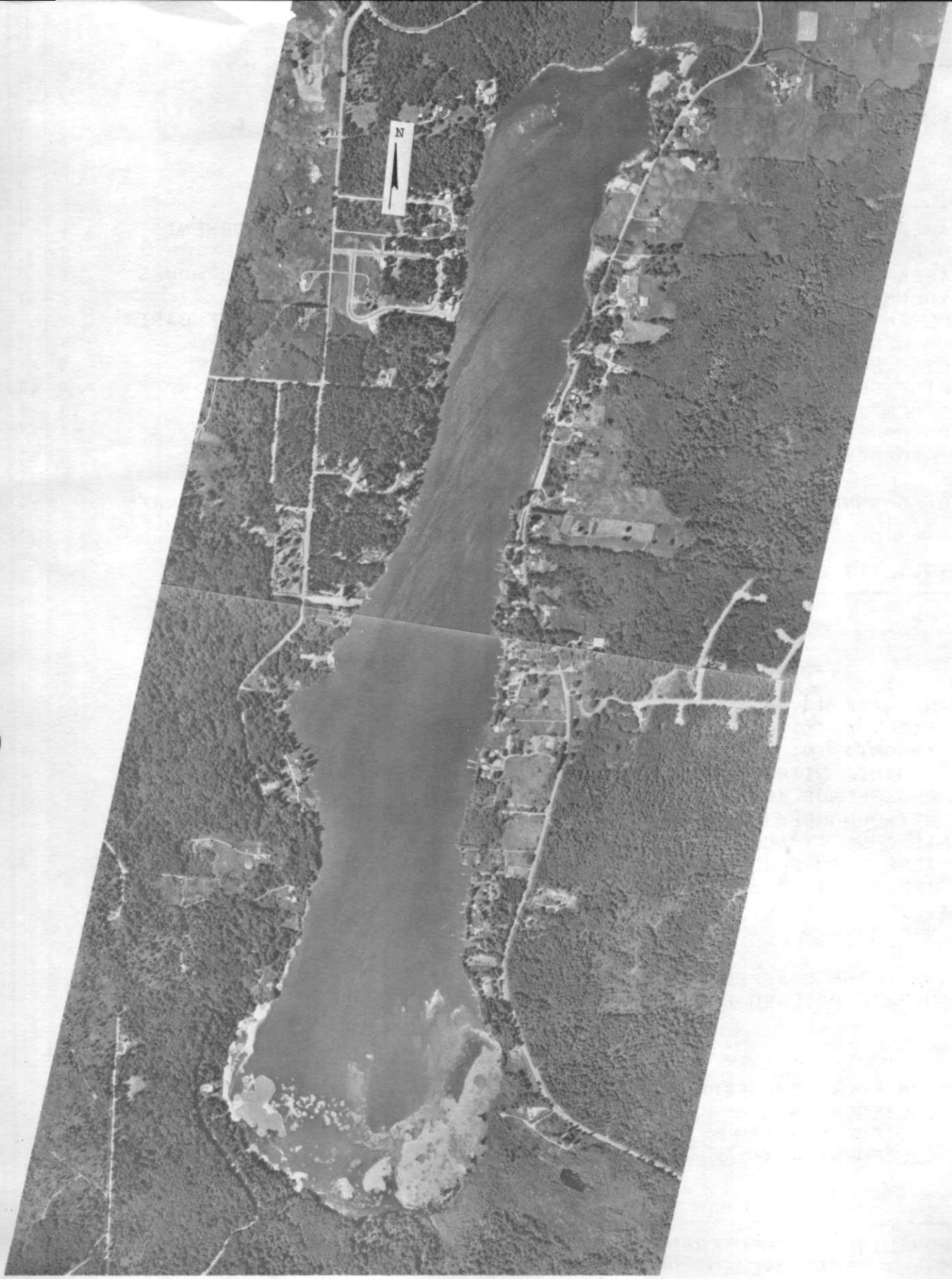
| | |
|---|---|
| DATE | 6/22/73 |
| TIME | 1300 |
| NUMBER OF FECAL COLIFORM SAMPLES | 3 |
| FECAL COLIFORM, MINIMUM (COL./100ML) | <1 |
| FECAL COLIFORM, MAXIMUM (COL./100ML) | 400 |
| FECAL COLIFORM, MEAN (COL./100ML) | 207 |

REMARKS

A NARROW LAKE THAT STRETCHES TWO MILES IN LENGTH. MOST OF THE EMERSED AND SUBMERSED PLANTS WERE ON THE NORTH AND SOUTH ENDS OF THE LAKE. AN ALGAL BLOOM WAS OBSERVED. IN 1973 THE U.S. GEOLOGICAL SURVEY SAMPLED THE LAKE FOUR TIMES. THE PLANT SURVEY WAS MADE ON AUGUST 14, 1973.




Long Lake, Kitsap County. From U.S. Geological Survey, September 13, 1973.




Long Lake, Kitsap County. July 14, 1971. Approx. scale 1:14,000.

MILLER LAKE KITSAP COUNTY

LATITUDE 47°48'56" LONGITUDE 122°33'28" T27N-R2E-21
PUGET SOUND BASIN

| PHYSICAL DATA | | CULTURAL DATA | |
|---|---|---|---|
| DRAINAGE AREA | 1.23 SQ MI | RESIDENTIAL DEVELOPMENT | 0 % |
| ALTITUDE | 50. FT | | |
| LAKE AREA | 31. ACRES | NUMBER OF NEARSHORE HOMES | 0 |
| LAKE VOLUME | 640. ACRE-FT | | |
| MEAN DEPTH | 20. FT | LAND USE IN DRAINAGE BASIN | |
| MAXIMUM DEPTH | 30. FT | | |
| SHORELINE LENGTH | 0.80 MI | RESIDENTIAL URBAN | 0 % |
| SHORELINE CONFIGURATION | 1.0 | RESIDENTIAL SUBURBAN | 0 % |
| DEVELOPMENT OF VOLUME | 0.68 | AGRICULTURAL | 11 % |
| BOTTOM SLOPE | 2.3 % | FOREST OR UNPRODUCTIVE | 85 % |
| BASIN GEOLOGY | SED./META. | LAKE SURFACE | 4 % |
| INFLOW | INTERMITTENT | | |
| OUTFLOW CHANNEL | PRESENT | PUBLIC BOAT ACCESS TO LAKE | -- |

WATER-QUALITY DATA (IN MG/L UNLESS OTHERWISE INDICATED)

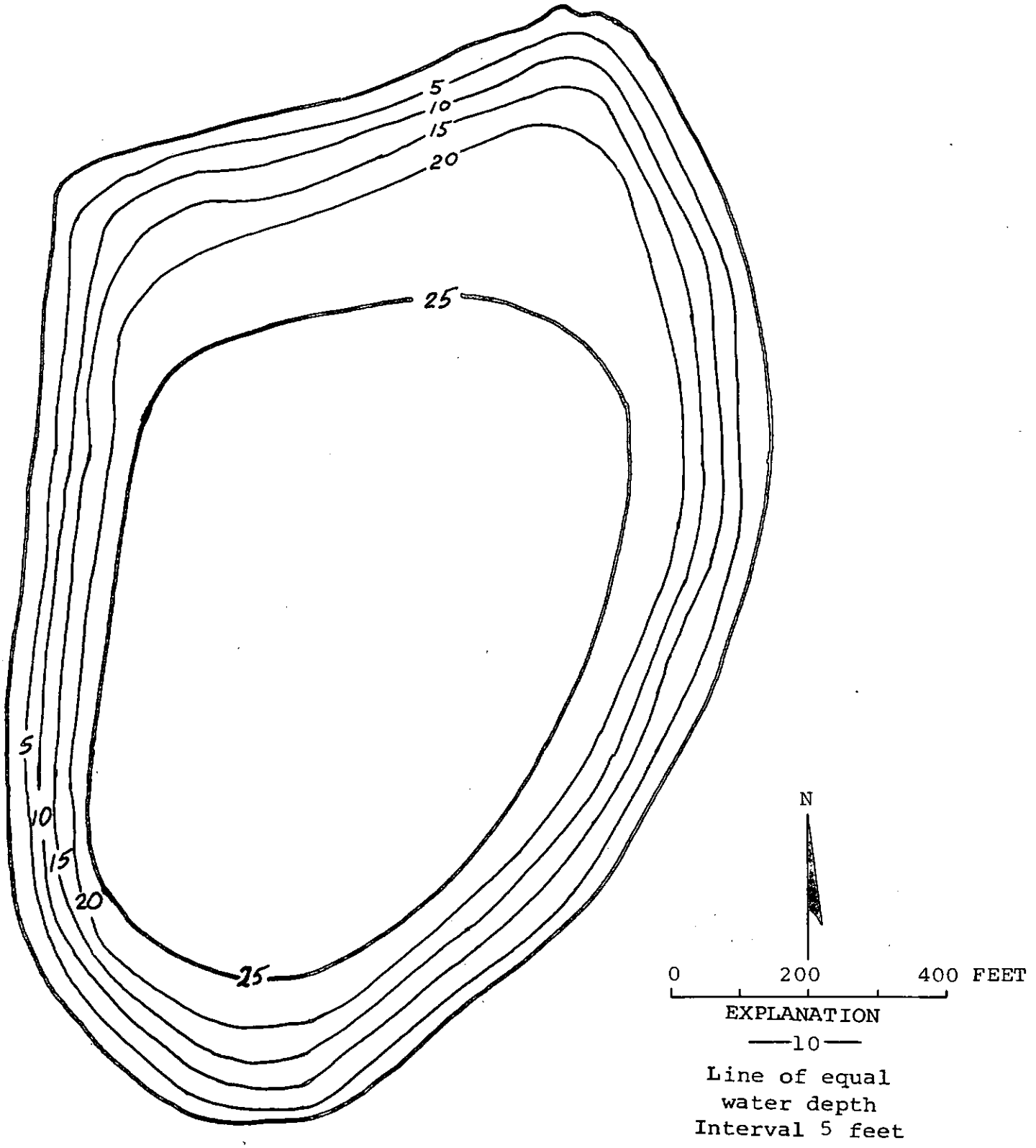
| SAMPLE SITE | 1 | |
|---|---|---|
| DATE | 8/ 5/74 | |
| TIME | 1205 | 1210 |
| DEPTH (FT) | 3. | 23. |
| TOTAL NITRATE (N) | 0.02 | 0.38 |
| TOTAL NITRITE (N) | 0.00 | 0.01 |
| TOTAL AMMONIA (N) | 0.15 | 0.15 |
| TOTAL ORGANIC NITROGEN (N) | 0.46 | 0.41 |
| TOTAL PHOSPHORUS (P) | 0.033 | 0.033 |
| TOTAL ORTHOPHOSPHATE (P) | 0.018 | 0.023 |
| SPECIFIC CONDUCTANCE (MICROMHOS) | 73 | 58 |
| WATER TEMPERATURE (DEG C) | 22.9 | 6.4 |
| COLOR (PLATINUM-COBALT UNITS) | 100 | 100 |
| SECCHI-DISC VISIBILITY (FT) | 3 | |
| DISSOLVED OXYGEN | 5.6 | 1.8 |

| | |
|---|---|
| LAKE SHORELINE COVERED BY EMERSED PLANTS | 76-100 % |
| LAKE SURFACE COVERED BY EMERSED PLANTS | 1- 10 % |

| | |
|---|---|
| DATE | 8/ 5/74 |
| TIME | 1225 |
| NUMBER OF FECAL COLIFORM SAMPLES | 3 |
| FECAL COLIFORM, MINIMUM (COL./100ML) | 1 |
| FECAL COLIFORM, MAXIMUM (COL./100ML) | 5 |
| FECAL COLIFORM, MEAN (COL./100ML) | 2 |

REMARKS

THE SHORELINE IS SHELTERED BY OVERHANGING TREES AND SHRUBS. EMERSED PLANTS (LILIES) COVERED THE SHORELINE IN A NARROW BAND. THERE WERE MANY LOGS AND SNAGS CLOSE TO SHORE.




Miller Lake, Kitsap County. From U.S. Geological Survey, April 3, 1974.


Miller Lake, Kitsap County. May 4, 1972. Approx. scale 1:12,000.

MISSION LAKE KITSAP COUNTY

LATITUDE 47*31'57" LONGITUDE 122*50' 5" T24N-R1W-32
PUGET SOUND BASIN

| PHYSICAL DATA | | CULTURAL DATA | |
|---|---|---|---|
| DRAINAGE AREA | 1.83 SQ MI | RESIDENTIAL DEVELOPMENT | 50 % |
| ALTITUDE | 516. FT | | |
| LAKE AREA | 88. ACRES | NUMBER OF NEARSHORE HOMES | 48 |
| LAKE VOLUME | 1000. ACRE-FT | | |
| MEAN DEPTH | 12. FT | LAND USE IN DRAINAGE BASIN | |
| MAXIMUM DEPTH | 25. FT | | |
| SHORELINE LENGTH | 1.9 MI | RESIDENTIAL URBAN | 0 % |
| SHORELINE CONFIGURATION | 1.4 | RESIDENTIAL SUBURBAN | 3 % |
| DEVELOPMENT OF VOLUME | 0.56 | AGRICULTURAL | 0 % |
| BOTTOM SLOPE | 0.91 % | FOREST OR UNPRODUCTIVE | 89 % |
| BASIN GEOLOGY | SED./META. | LAKE SURFACE | 8 % |
| INFLOW | INTERMITTENT | | |
| OUTFLOW CHANNEL | PRESENT | PUBLIC BOAT ACCESS TO LAKE | YES |

WATER-QUALITY DATA (IN MG/L UNLESS OTHERWISE INDICATED)

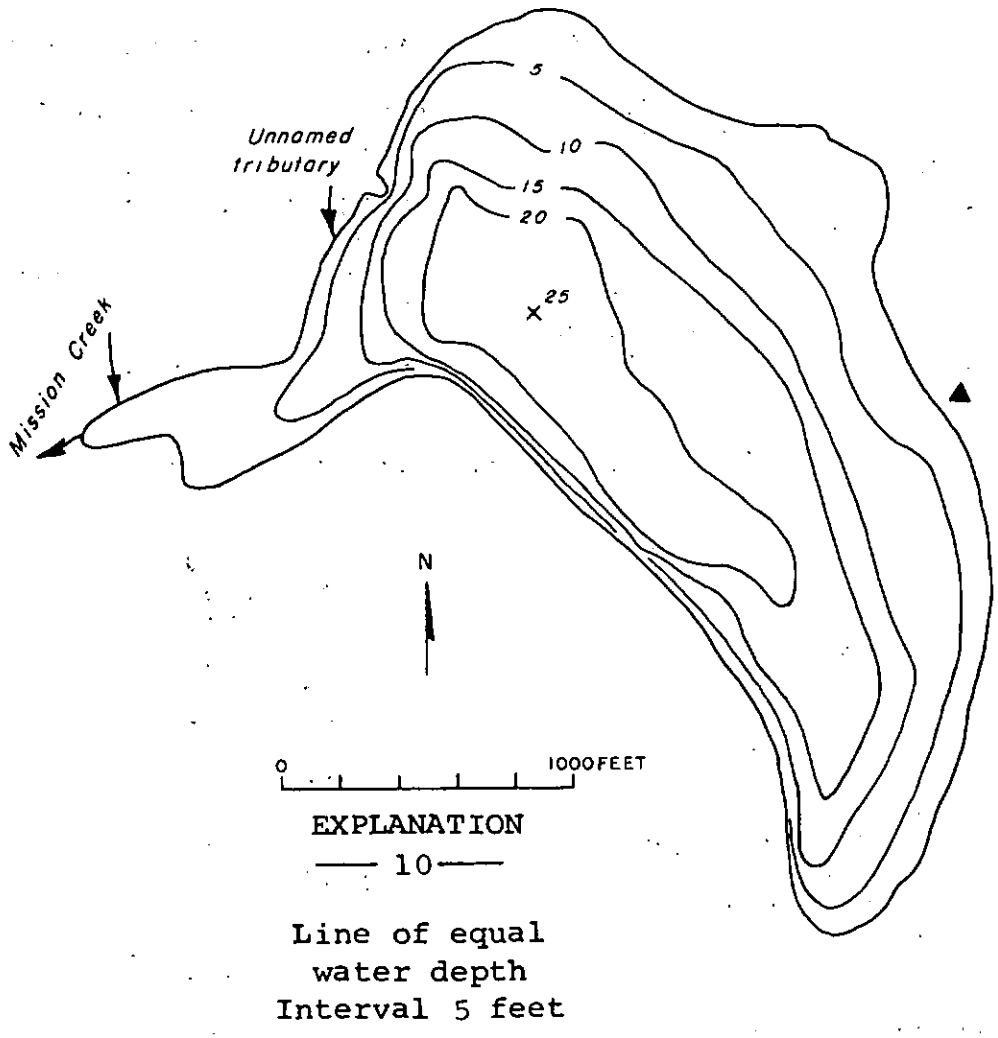
| SAMPLE SITE | 1 | |
|---|---|---|
| DATE | 10/ 6/70 | |
| TIME | 1445 | 1500 |
| DEPTH (FT) | 3. | 16. |
| DISSOLVED NITRATE (N) | 0.20 | 0.30 |
| TOTAL NITRITE (N) | -- | -- |
| TOTAL AMMONIA (N) | -- | -- |
| TOTAL ORGANIC NITROGEN (N) | -- | -- |
| TOTAL PHOSPHORUS (P) | 0.006 | 0.006 |
| DISSOLVED ORTHOPHOSPHATE (P) | 0.003 | 0.003 |
| SPECIFIC CONDUCTANCE (MICROMHOS) | 80 | 77 |
| WATER TEMPERATURE (DEG C) | 14.9 | 14.0 |
| COLOR (PLATINUM-COBALT UNITS) | 5 | -- |
| SECCHI-DISC VISIBILITY (FT) | 17 | |
| DISSOLVED OXYGEN | 10.3 | 9.8 |

| | |
|---|---|
| LAKE SHORELINE COVERED BY EMERSED PLANTS | 76-100 % |
| LAKE SURFACE COVERED BY EMERSED PLANTS | 1- 10 % |

| | |
|---|---|
| DATE | 9/ 5/74 |
| TIME | 1330 |
| NUMBER OF FECAL COLIFORM SAMPLES | 3 |
| FECAL COLIFORM, MINIMUM (COL./100ML) | <1 |
| FECAL COLIFORM, MAXIMUM (COL./100ML) | <1 |
| FECAL COLIFORM, MEAN (COL./100ML) | <1 |

REMARKS

EMERSED PLANTS (CATTAILS AND SEDGES) COVERED MOST OF THE SHORELINE. SUBMERSED PLANTS (ELODEA AND PONDWEED) WERE OBSERVED IN SCATTERED BEDS. IN 1970 THE U.S GEOLOGICAL SURVEY SAMPLED THE LAKE THREE TIMES. THE PLANT SURVEY WAS MADE ON OCTOBER 6, 1970.




Mission Lake, Kitsap County. From Washington Department of Game, June 8, 1946.


Mission Lake, Kitsap County. July 14, 1971. Approx. scale 1:6700.

PANTHER LAKE KITSAP COUNTY

LATITUDE 47*31'33" LONGITUDE 122*51'18" T24N-R1W-31
TAHUYA RIVER BASIN

| PHYSICAL DATA | | CULTURAL DATA | |
|---|---|---|---|
| DRAINAGE AREA | 0.80 SQ MI | RESIDENTIAL DEVELOPMENT | 71 % |
| ALTITUDE | 497. FT | | |
| LAKE AREA | 100. ACRES | NUMBER OF NEARSHORE HOMES | 59 |
| LAKE VOLUME | 1400. ACRE-FT | | |
| MEAN DEPTH | 13. FT | LAND USE IN DRAINAGE BASIN | |
| MAXIMUM DEPTH | 25. FT | | |
| SHORELINE LENGTH | 1.8 MI | RESIDENTIAL URBAN | 0 % |
| SHORELINE CONFIGURATION | 1.2 | RESIDENTIAL SUBURBAN | 5 % |
| DEVELOPMENT OF VOLUME | 0.53 | AGRICULTURAL | 0 % |
| BOTTOM SLOPE | 1.0 % | FOREST OR UNPRODUCTIVE | 75 % |
| BASIN GEOLOGY | SED./META. | LAKE SURFACE | 20 % |
| INFLOW | NONE VISIBLE | | |
| OUTFLOW CHANNEL | PRESENT | PUBLIC BOAT ACCESS TO LAKE | YES |

WATER-QUALITY DATA (IN MG/L UNLESS OTHERWISE INDICATED)

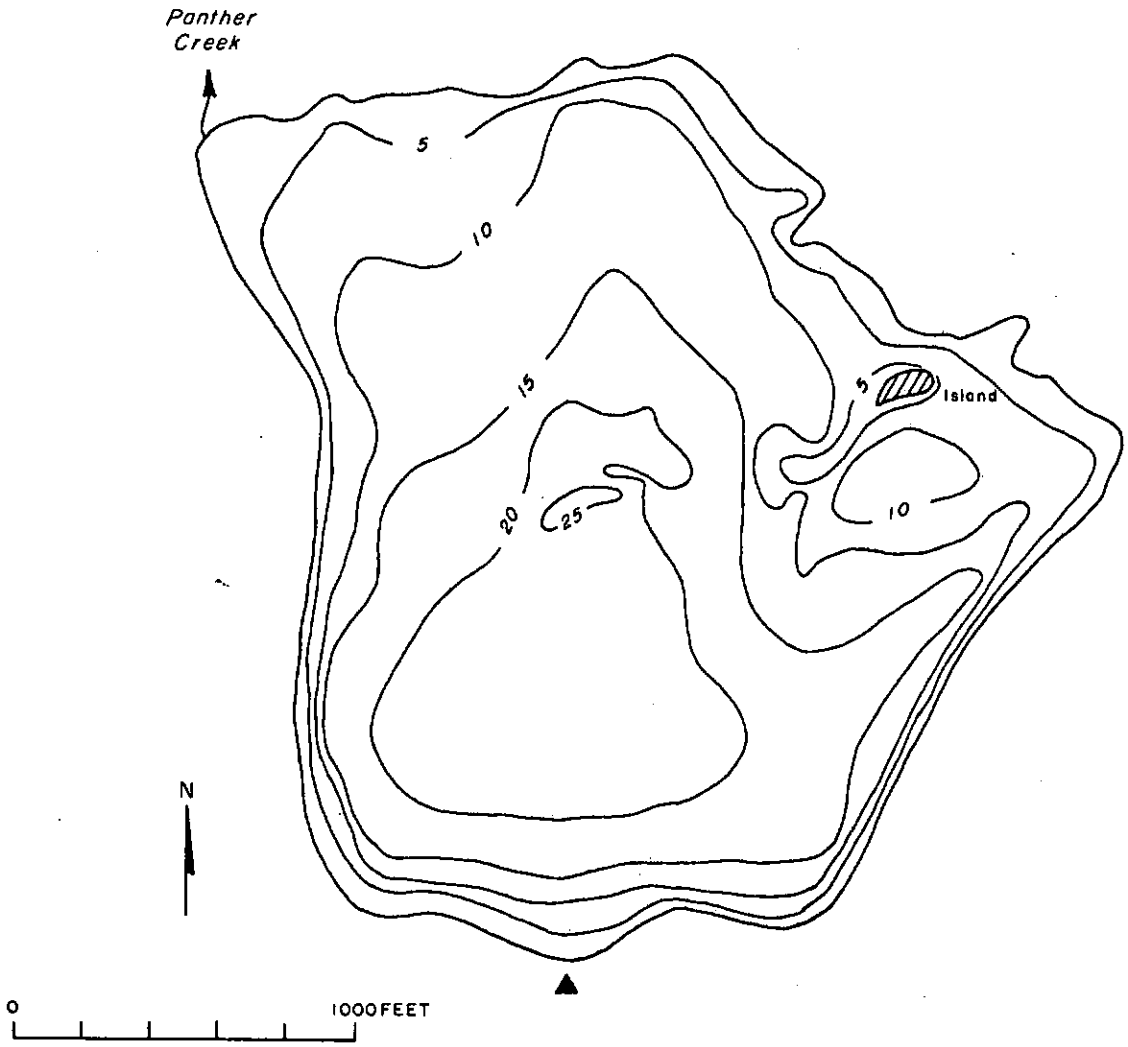
| SAMPLE SITE | 1 | |
|---|---|---|
| DATE | 10/ 6/70 | |
| TIME | 1130 | 1120 |
| DEPTH (FT) | 3. | 17. |
| DISSOLVED NITRATE (N) | 0.09 | 0.00 |
| TOTAL NITRITE (N) | -- | -- |
| TOTAL AMMONIA (N) | -- | -- |
| TOTAL ORGANIC NITROGEN (N) | -- | -- |
| TOTAL PHOSPHORUS (P) | 0.013 | 0.020 |
| DISSOLVED ORTHOPHOSPHATE (P) | 0.006 | 0.020 |
| SPECIFIC CONDUCTANCE (MICROMHOS) | 22 | -- |
| WATER TEMPERATURE (DEG C) | 14.9 | 14.8 |
| COLOR (PLATINUM-COBALT UNITS) | 5 | -- |
| SECCHI-DISC VISIBILITY (FT) | 10 | |
| DISSOLVED OXYGEN | 10.1 | 9.7 |

| | |
|---|---|
| LAKE SHORELINE COVERED BY EMERSED PLANTS | 76-100 % |
| LAKE SURFACE COVERED BY EMERSED PLANTS | NONE OR <1 % |

| | |
|---|---|
| DATE | 9/ 5/74 |
| TIME | 1320 |
| NUMBER OF FECAL COLIFORM SAMPLES | 3 |
| FECAL COLIFORM, MINIMUM (COL./100ML) | <1 |
| FECAL COLIFORM, MAXIMUM (COL./100ML) | 1 |
| FECAL COLIFORM, MEAN (COL./100ML) | <1 |

REMARKS

EXCEPT FOR A VERY THIN MARGIN OF EMERSED PLANTS AROUND THE SHORE, VERY FEW AQUATIC MACROPHYTES WERE OBSERVED. THE DO WAS NEAR SATURATION THROUGHOUT THE WATER COLUMN. IN 1970 THE U.S. GEOLOGICAL SURVEY SAMPLED THE LAKE THREE TIMES. THE PLANT SURVEY WAS MADE ON OCTOBER 6, 1970.

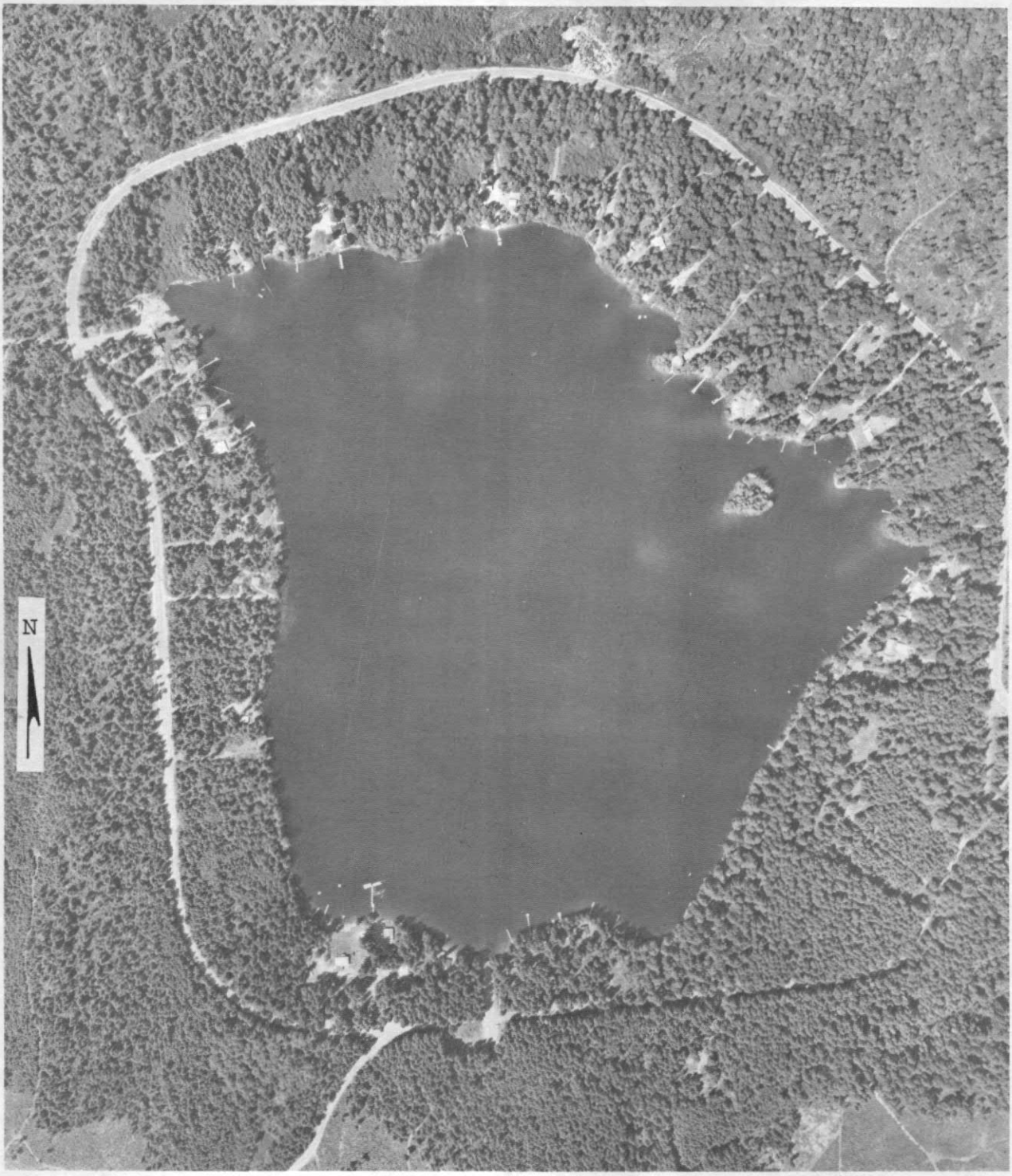



EXPLANATION

— 10 —

Line of equal
water depth
Interval 5 feet

Panther Lake, Kitsap County. From Washington Department of Game, June 2, 1949.




Panther Lake, Kitsap County. July 14, 1971. Approx. scale 1:6500.

TAHUYA LAKE KITSAP COUNTY

LATITUDE 47*33'32" LONGITUDE 122*50' 3" T24N-R1W-20
TAHUYA RIVER BASIN

| PHYSICAL DATA | | CULTURAL DATA | |
|---|---|---|---|
| DRAINAGE AREA | 5.69 SQ MI | RESIDENTIAL DEVELOPMENT | 51 % |
| ALTITUDE | 580. FT | | |
| LAKE AREA | 150. ACRES | NUMBER OF NEARSHORE HOMES | 40 |
| LAKE VOLUME | 1100. ACRE-FT | | |
| MEAN DEPTH | 7. FT | LAND USE IN DRAINAGE BASIN | |
| MAXIMUM DEPTH | 17. FT | | |
| SHORELINE LENGTH | 3.7 MI | RESIDENTIAL URBAN | 0 % |
| SHORELINE CONFIGURATION | 2.1 | RESIDENTIAL SUBURBAN | 1 % |
| DEVELOPMENT OF VOLUME | 0.41 | AGRICULTURAL | 0 % |
| BOTTOM SLOPE | 0.58 % | FOREST OR UNPRODUCTIVE | 95 % |
| BASIN GEOLOGY | SED./META. | LAKE SURFACE | 4 % |
| INFLOW | PERENNIAL | | |
| OUTFLOW CHANNEL | PRESENT | PUBLIC BOAT ACCESS TO LAKE | YES |

WATER-QUALITY DATA (IN MG/L UNLESS OTHERWISE INDICATED)

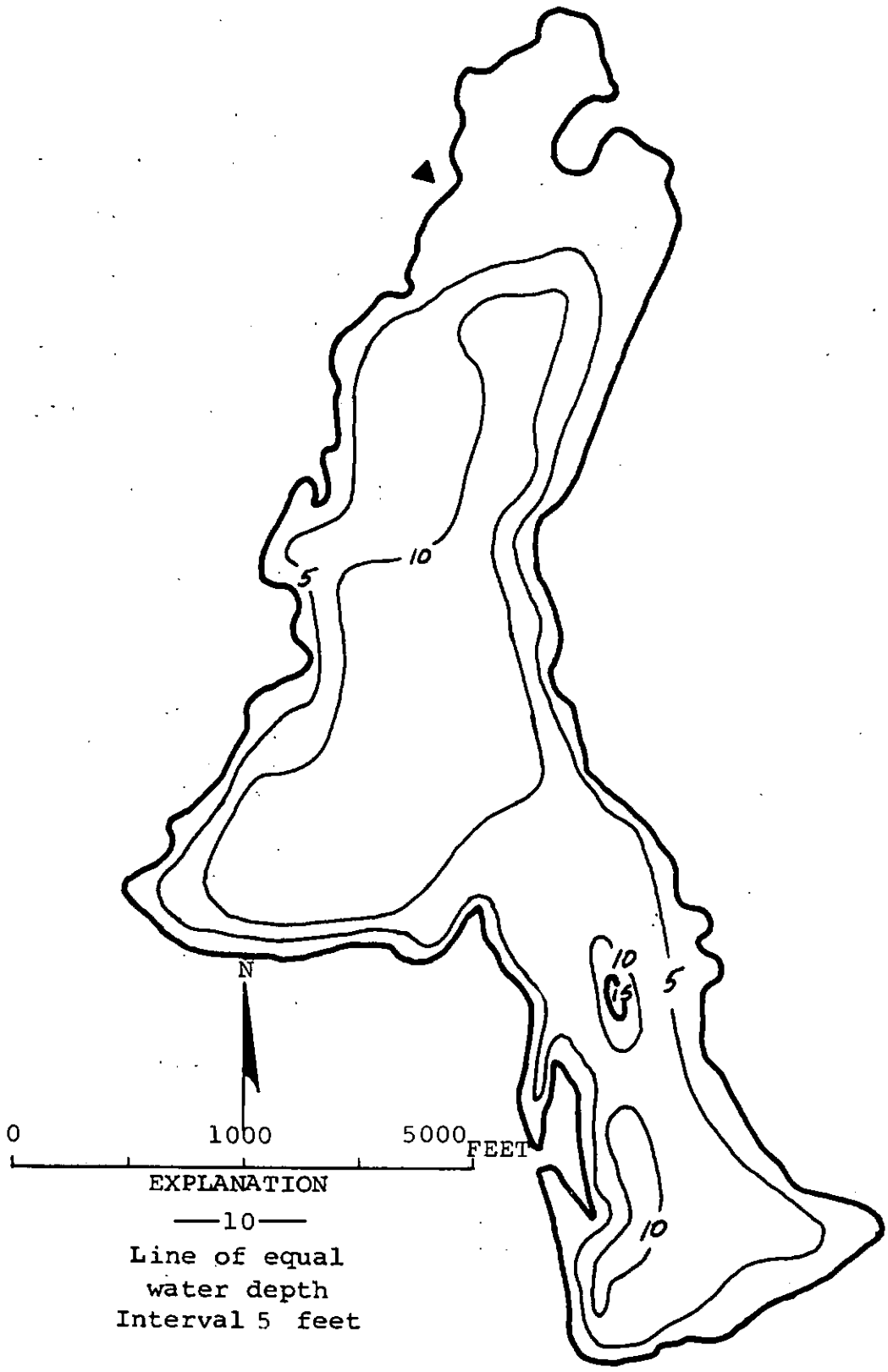
| SAMPLE SITE | 1 | |
|---|---|---|
| DATE | 9/ 5/74 | |
| TIME | 1245 | 1250 |
| DEPTH (FT) | 3. | 8. |
| TOTAL NITRATE (N) | 0.01 | 0.01 |
| TOTAL NITRITE (N) | 0.00 | 0.00 |
| TOTAL AMMONIA (N) | 0.04 | 0.08 |
| TOTAL ORGANIC NITROGEN (N) | 0.24 | 0.17 |
| TOTAL PHOSPHORUS (P) | 0.004 | 0.003 |
| TOTAL ORTHOPHOSPHATE (P) | 0.003 | 0.002 |
| SPECIFIC CONDUCTANCE (MICROMHOS) | 68 | 68 |
| WATER TEMPERATURE (DEG C) | 20.0 | 20.0 |
| COLOR (PLATINUM-COBALT UNITS) | 15 | 20 |
| SECCHI-DISC VISIBILITY (FT) | 8 | |
| DISSOLVED OXYGEN | 6.9 | 6.5 |

| | |
|---|---|
| LAKE SHORELINE COVERED BY EMERSED PLANTS | 76-100 % |
| LAKE SURFACE COVERED BY EMERSED PLANTS | 51- 75 % |

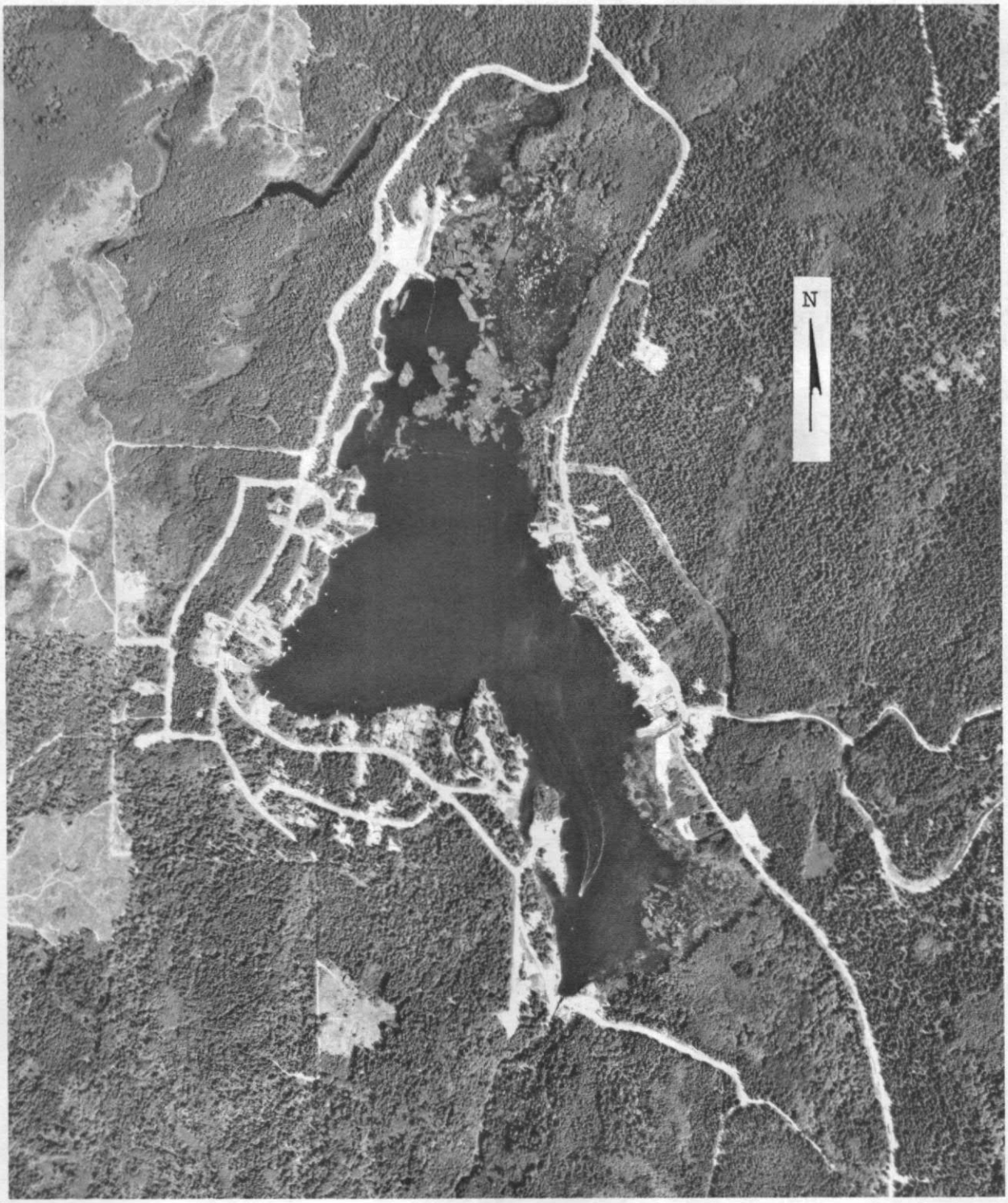
| | |
|---|---|
| DATE | 9/ 5/74 |
| TIME | 1300 |
| NUMBER OF FECAL COLIFORM SAMPLES | 4 |
| FECAL COLIFORM, MINIMUM (COL./100ML) | <1 |
| FECAL COLIFORM, MAXIMUM (COL./100ML) | 9 |
| FECAL COLIFORM, MEAN (COL./100ML) | 5 |

REMARKS

THE ORIGINAL LAKE WHICH WAS SURROUNDED BY A LARGE MARSH HAS BEEN ENLARGED BY A DAM ON THE TAHUYA RIVER. THE LAKE HAD A DENSE COVER OF BOTH EMERSED AND SUBMERSED PLANTS. MOST OF THE LAKE BOTTOM WAS COVERED WITH SUBMERSED AQUATIC PLANTS.




Tahuya Lake, Kitsap County. From U.S. Geological Survey, February 19, 1974.




Tahuya Lake, Kitsap County. May 28, 1972. Approx. scale 1:12,000.

TWIN LAKE KITSAP COUNTY

LATITUDE 47°31'12" LONGITUDE 122°45'40" T23N-R1W-2
PUGET SOUND BASIN

| PHYSICAL DATA | | CULTURAL DATA | |
|---|---|---|---|
| DRAINAGE AREA | 0.42 SQ MI | RESIDENTIAL DEVELOPMENT | 0 % |
| ALTITUDE | 272. FT | | |
| LAKE AREA | 9. ACRES | NUMBER OF NEARSHORE HOMES | 0 |
| LAKE VOLUME | 88. ACRE-FT | | |
| MEAN DEPTH | 10. FT | LAND USE IN DRAINAGE BASIN | |
| MAXIMUM DEPTH | 15. FT | | |
| SHORELINE LENGTH | 0.46 MI | RESIDENTIAL URBAN | 0 % |
| SHORELINE CONFIGURATION | 1.1 | RESIDENTIAL SUBURBAN | 0 % |
| DEVELOPMENT OF VOLUME | 0.67 | AGRICULTURAL | 0 % |
| BOTTOM SLOPE | 2.1 % | FOREST OR UNPRODUCTIVE | 97 % |
| BASIN GEOLOGY | SED./META. | LAKE SURFACE | 3 % |
| INFLOW | INTERMITTENT | | |
| OUTFLOW CHANNEL | ABSENT | PUBLIC BOAT ACCESS TO LAKE | -- |

WATER-QUALITY DATA (IN MG/L UNLESS OTHERWISE INDICATED)

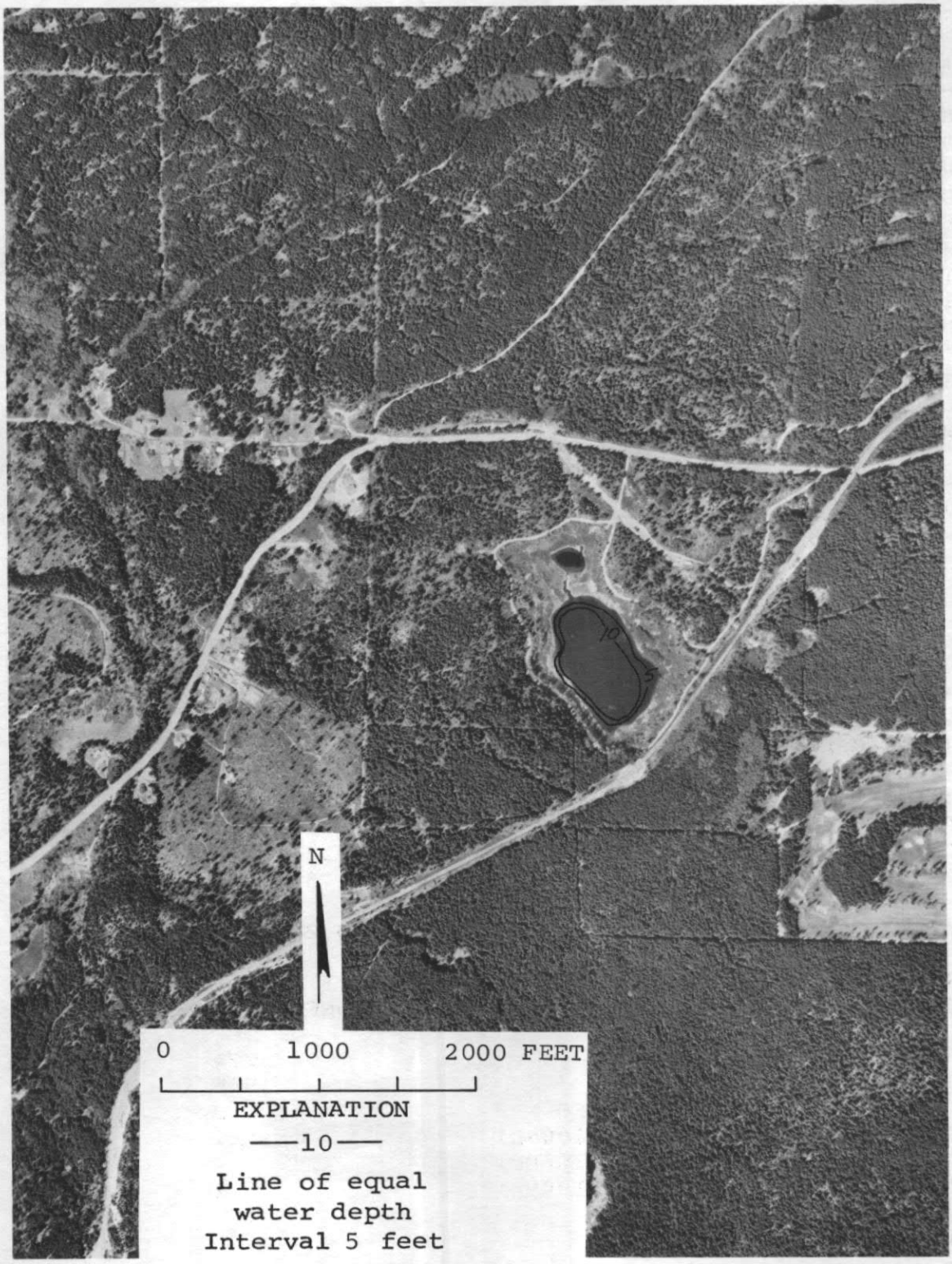
| SAMPLE SITE | 1 | |
|---|---|---|
| DATE | 9/ 5/74 | |
| TIME | 1430 | 1435 |
| DEPTH (FT) | 3. | 16. |
| TOTAL NITRATE (N) | 0.01 | 0.00 |
| TOTAL NITRITE (N) | 0.00 | 0.00 |
| TOTAL AMMONIA (N) | 0.02 | 0.03 |
| TOTAL ORGANIC NITROGEN (N) | 0.16 | 0.14 |
| TOTAL PHOSPHORUS (P) | 0.005 | 0.006 |
| TOTAL ORTHOPHOSPHATE (P) | 0.003 | 0.002 |
| SPECIFIC CONDUCTANCE (MICROMHOS) | 46 | 46 |
| WATER TEMPERATURE (DEG C) | 21.8 | 21.6 |
| COLOR (PLATINUM-COBALT UNITS) | 5 | 5 |
| SECCHI-DISC VISIBILITY (FT) | 9 | |
| DISSOLVED OXYGEN | 7.8 | 7.4 |

| | |
|---|---|
| LAKE SHORELINE COVERED BY EMERSED PLANTS | LITTLE OR NONE |
| LAKE SURFACE COVERED BY EMERSED PLANTS | NONE OR <1 % |

| | |
|---|---|
| DATE | 9/ 5/74 |
| TIME | 1445 |
| NUMBER OF FECAL COLIFORM SAMPLES | 3 |
| FECAL COLIFORM, MINIMUM (COL./100ML) | 3 |
| FECAL COLIFORM, MAXIMUM (COL./100ML) | 5 |
| FECAL COLIFORM, MEAN (COL./100ML) | 4 |

REMARKS

FEW AQUATIC MACROPHYTES WERE OBSERVED. TREES AND SHRUBS OVERHANG THE SHORELINE.




Twin Lake, Kitsap County. Bathymetric map from U.S. Geological Survey, February 22, 1974. Aerial photo, May 4, 1972.

UNION RIVER LAKE KITSAP COUNTY

LATITUDE 47°32'14" LONGITUDE 122°46'42" T24N-R1W-27
PUGET SOUND BASIN

| PHYSICAL DATA | | CULTURAL DATA | |
|---|---|---|---|
| DRAINAGE AREA | 3.00 SQ MI | RESIDENTIAL DEVELOPMENT | 0 % |
| ALTITUDE | 640. FT | | |
| LAKE AREA | 92. ACRES | NUMBER OF NEARSHORE HOMES | 0 |
| LAKE VOLUME | 4100. ACRE-FT | | |
| MEAN DEPTH | 45. FT | LAND USE IN DRAINAGE BASIN | |
| MAXIMUM DEPTH | 130. FT | | |
| SHORELINE LENGTH | 3.1 MI | RESIDENTIAL URBAN | 0 % |
| SHORELINE CONFIGURATION | 2.3 | RESIDENTIAL SUBURBAN | 0 % |
| DEVELOPMENT OF VOLUME | 0.35 | AGRICULTURAL | 0 % |
| BOTTOM SLOPE | 5.8 % | FOREST OR UNPRODUCTIVE | 95 % |
| BASIN GEOLOGY | SED./META. | LAKE SURFACE | 5 % |
| INFLOW | PERENNIAL | | |
| OUTFLOW CHANNEL | PRESENT | PUBLIC BOAT ACCESS TO LAKE | -- |

WATER-QUALITY DATA (IN MG/L UNLESS OTHERWISE INDICATED)

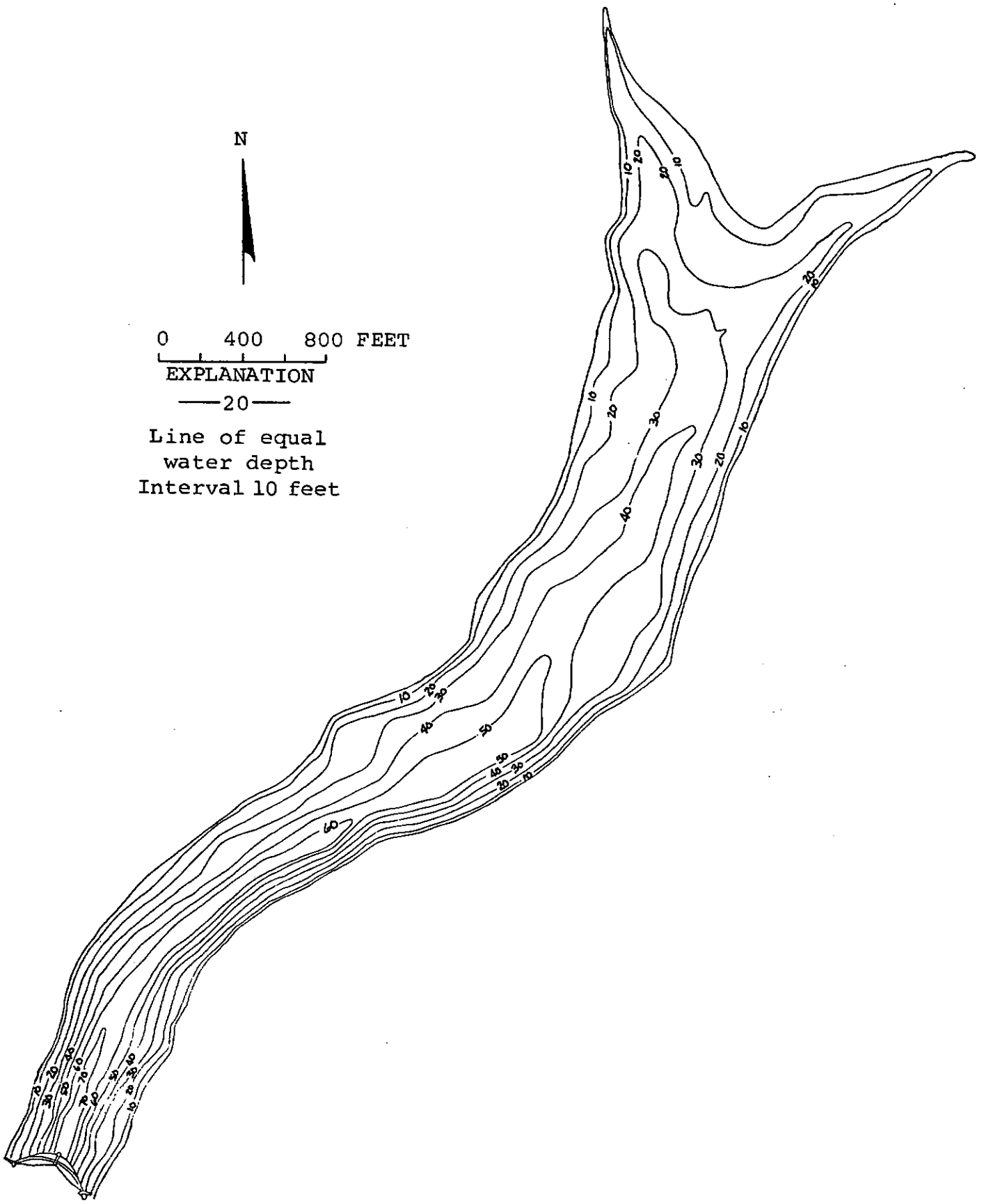
| SAMPLE SITE | 1 | |
|---|---|---|
| DATE | 9/ 5/74 | |
| TIME | 1530 | 1535 |
| DEPTH (FT) | 3. | 72. |
| TOTAL NITRATE (N) | 0.01 | 0.08 |
| TOTAL NITRITE (N) | 0.00 | 0.00 |
| TOTAL AMMONIA (N) | 0.02 | 0.05 |
| TOTAL ORGANIC NITROGEN (N) | 0.09 | 0.05 |
| TOTAL PHOSPHORUS (P) | 0.003 | 0.004 |
| TOTAL ORTHOPHOSPHATE (P) | 0.002 | 0.001 |
| SPECIFIC CONDUCTANCE (MICROMHOS) | 71 | 69 |
| WATER TEMPERATURE (DEG C) | 19.3 | 8.0 |
| COLOR (PLATINUM-COBALT UNITS) | 5 | 5 |
| SECCHI-DISC VISIBILITY (FT) | 26 | |
| DISSOLVED OXYGEN | 9.2 | 4.1 |

| | |
|---|---|
| LAKE SHORELINE COVERED BY EMERSED PLANTS | LITTLE OR NONE |
| LAKE SURFACE COVERED BY EMERSED PLANTS | NONE OR <1 % |

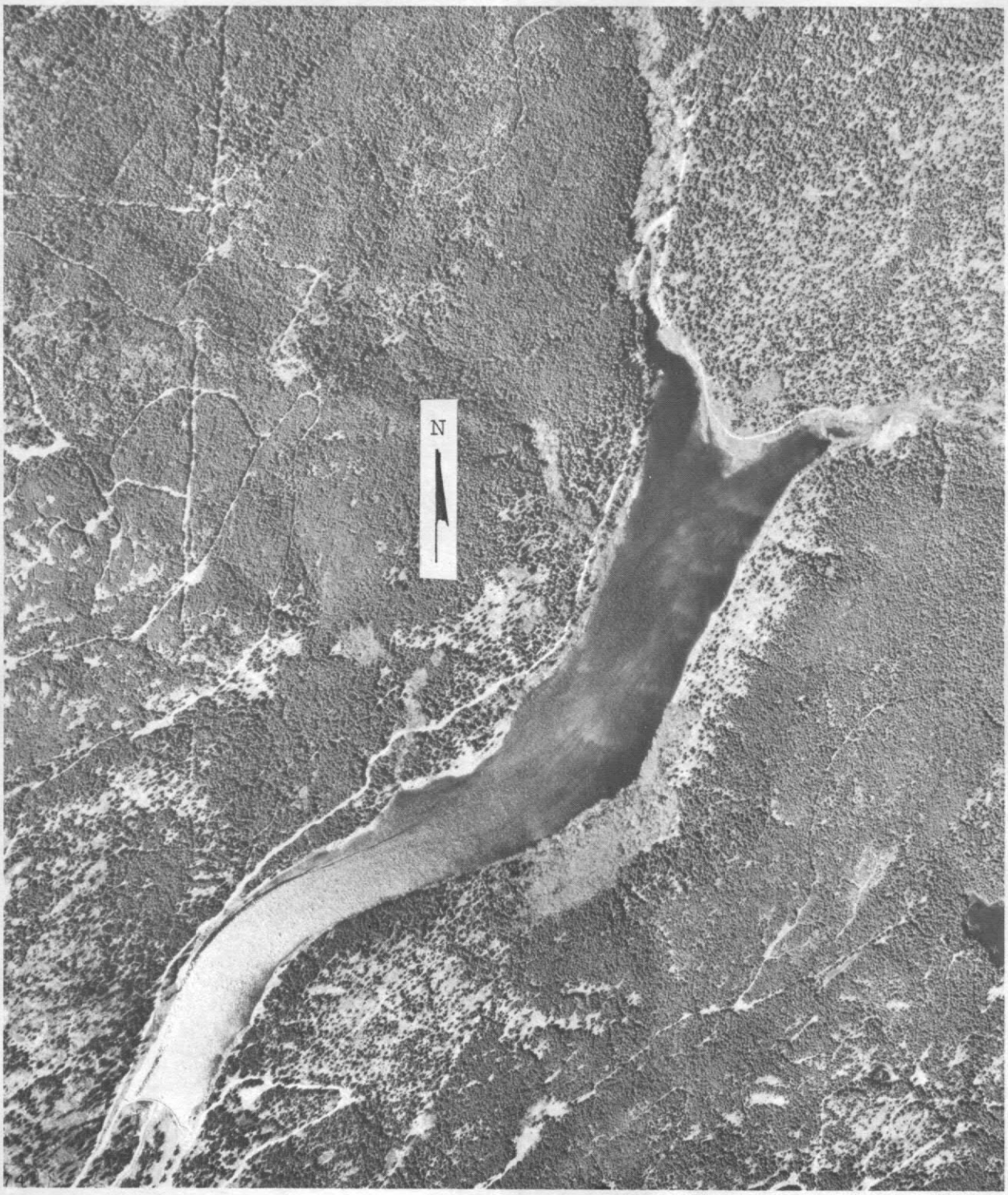
| | |
|---|---|
| DATE | 9/ 5/74 |
| TIME | 1545 |
| NUMBER OF FECAL COLIFORM SAMPLES | 3 |
| FECAL COLIFORM, MINIMUM (COL./100ML) | <1 |
| FECAL COLIFORM, MAXIMUM (COL./100ML) | 4 |
| FECAL COLIFORM, MEAN (COL./100ML) | 1 |

REMARKS

A WATER-SUPPLY RESERVOIR FOR THE CITY OF BREMERTON CREATED BY A DAM ON THE UNION RIVER. THE SHORELINE IS A STEEP GRAVEL BANK. NO AQUATIC MACROPHYTES WERE OBSERVED.




Union River Lake, Kitsap County. From City of Bremerton, date unknown.




Union River Lake, Kitsap County. May 4, 1972. Approx. scale 1:12,000.

WILDCAT LAKE KITSAP COUNTY

LATITUDE 47*35'59" LONGITUDE 122*45'35" T24N-R1W-2
PUGET SOUND BASIN

| PHYSICAL DATA | | CULTURAL DATA | |
|---|---|---|---|
| DRAINAGE AREA | 2.50 SQ MI | RESIDENTIAL DEVELOPMENT | 84 % |
| ALTITUDE | 377. FT | | |
| LAKE AREA | 120. ACRES | NUMBER OF NEARSHORE HOMES | 75 |
| LAKE VOLUME | 2200. ACRE-FT | | |
| MEAN DEPTH | 18. FT | LAND USE IN DRAINAGE BASIN | |
| MAXIMUM DEPTH | 33. FT | | |
| SHORELINE LENGTH | 2.2 MI | RESIDENTIAL URBAN | 0 % |
| SHORELINE CONFIGURATION | 1.4 | RESIDENTIAL SUBURBAN | 6 % |
| DEVELOPMENT OF VOLUME | 0.58 | AGRICULTURAL | <1 % |
| BOTTOM SLOPE | 1.2 % | FOREST OR UNPRODUCTIVE | 86 % |
| BASIN GEOLOGY | SED./META. | LAKE SURFACE | 8 % |
| INFLOW | INTERMITTENT | | |
| OUTFLOW CHANNEL | PRESENT | PUBLIC BOAT ACCESS TO LAKE | YES |

WATER-QUALITY DATA (IN MG/L UNLESS OTHERWISE INDICATED)

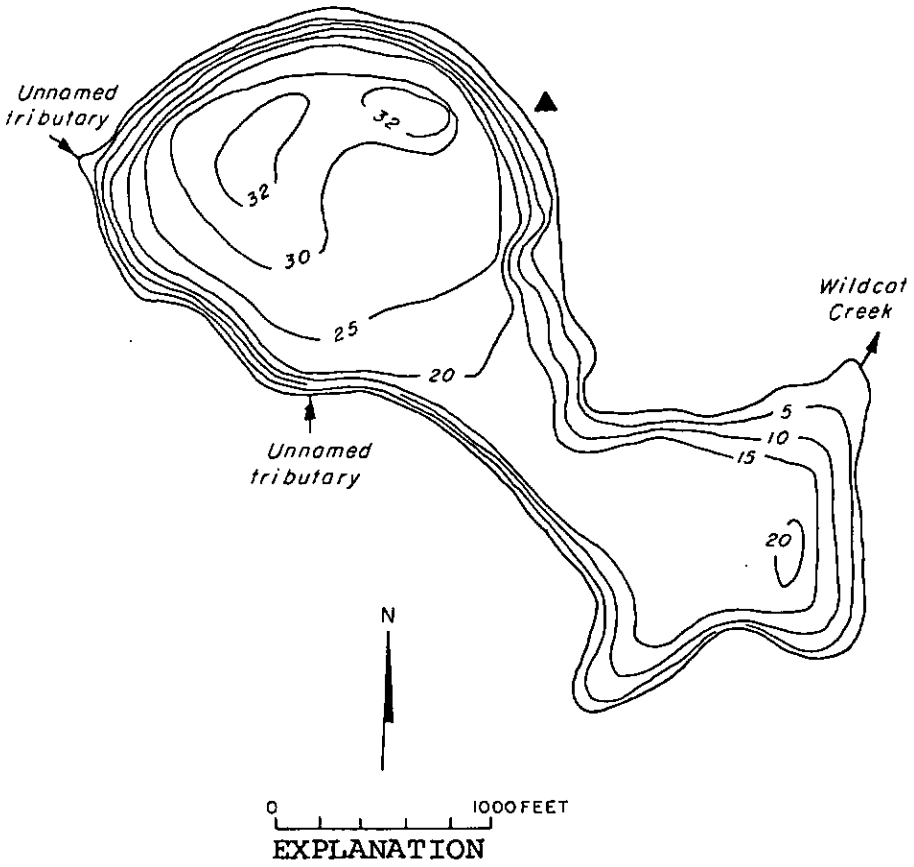
| SAMPLE SITE | 1 | |
|---|---|---|
| DATE | 9/ 8/71 | |
| TIME | 915 | 925 |
| DEPTH (FT) | 3. | 27. |
| DISSOLVED NITRATE (N) | 0.09 | 0.09 |
| TOTAL NITRITE (N) | -- | -- |
| TOTAL AMMONIA (N) | 0.07 | 0.04 |
| TOTAL ORGANIC NITROGEN (N) | 0.10 | 0.08 |
| TOTAL PHOSPHORUS (P) | 0.010 | 0.020 |
| DISSOLVED ORTHOPHOSPHATE (P) | 0.000 | 0.000 |
| SPECIFIC CONDUCTANCE (MICROMHOS) | 44 | 52 |
| WATER TEMPERATURE (DEG C) | 18.8 | 10.0 |
| COLOR (PLATINUM-COBALT UNITS) | 10 | 25 |
| SECCHI-DISC VISIBILITY (FT) | 13 | |
| DISSOLVED OXYGEN | 9.2 | 0.5 |

| | |
|---|---|
| LAKE SHORELINE COVERED BY EMERSED PLANTS | 51- 75 % |
| LAKE SURFACE COVERED BY EMERSED PLANTS | 1- 10 % |

| | |
|---|---|
| DATE | 9/ 5/74 |
| TIME | 1050 |
| NUMBER OF FECAL COLIFORM SAMPLES | 3 |
| FECAL COLIFORM, MINIMUM (COL./100ML) | 5 |
| FECAL COLIFORM, MAXIMUM (COL./100ML) | 7 |
| FECAL COLIFORM, MEAN (COL./100ML) | 6 |

REMARKS

IN 1971 THE U.S. GEOLOGICAL SURVEY SAMPLED THE LAKE FOUR TIMES. THE PLANT SURVEY WAS MADE ON SEPTEMBER 8, 1971.




Wildcat Lake, Kitsap County. From Washington Department of Game, June 11, 1946.


Wildcat Lake, Kitsap County. May 4, 1972. Approx. scale 1:12,000.

WILLIAM SYMINGTON LAKE KITSAP COUNTY

LATITUDE 47*35'56" LONGITUDE 122*49'27" T24N-R1W-5
PUGET SOUND BASIN

| PHYSICAL DATA | | CULTURAL DATA | |
|---|---|---|---|
| DRAINAGE AREA | 6.95 SQ MI | RESIDENTIAL DEVELOPMENT | 19 % |
| ALTITUDE | 390. FT | | |
| LAKE AREA | 60. ACRES | NUMBER OF NEARSHORE HOMES | 10 |
| LAKE VOLUME | 420. ACRE-FT | | |
| MEAN DEPTH | 7. FT | LAND USE IN DRAINAGE BASIN | |
| MAXIMUM DEPTH | 23. FT | | |
| SHORELINE LENGTH | 2.7 MI | RESIDENTIAL URBAN | 0 % |
| SHORELINE CONFIGURATION | 2.5 | RESIDENTIAL SUBURBAN | 1 % |
| DEVELOPMENT OF VOLUME | 0.31 | AGRICULTURAL | 3 % |
| BOTTOM SLOPE | 1.3 % | FOREST OR UNPRODUCTIVE | 95 % |
| BASIN GEOLOGY | SED./META. | LAKE SURFACE | 1 % |
| INFLOW | PERENNIAL | | |
| OUTFLOW CHANNEL | PRESENT | PUBLIC BOAT ACCESS TO LAKE | -- |

WATER-QUALITY DATA (IN MG/L UNLESS OTHERWISE INDICATED)

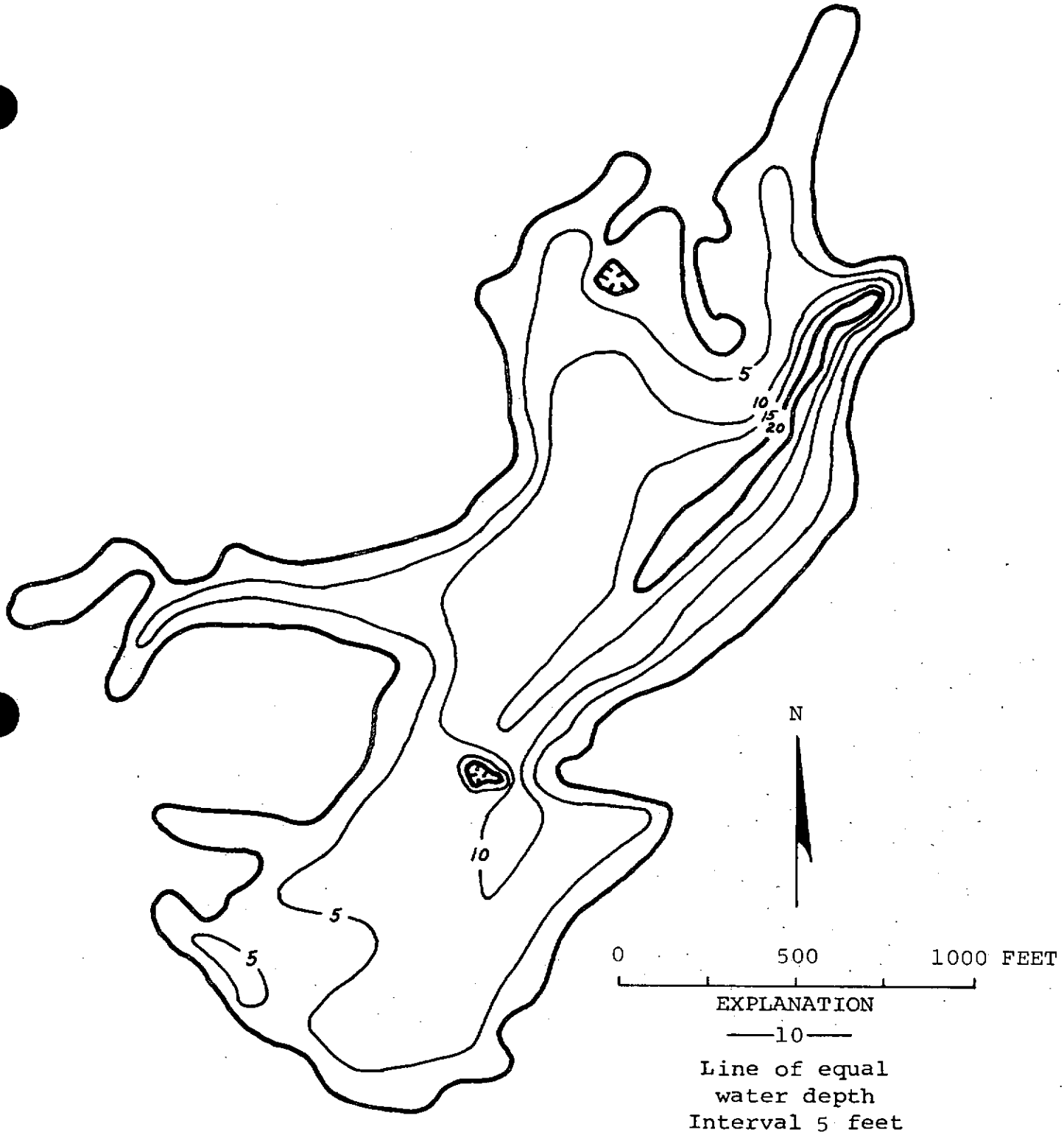
| SAMPLE SITE | 1 | |
|---|---|---|
| DATE | 9/ 5/74 | |
| TIME | 1135 | 1140 |
| DEPTH (FT) | 3. | 8. |
| TOTAL NITRATE (N) | 0.00 | 0.01 |
| TOTAL NITRITE (N) | 0.00 | 0.00 |
| TOTAL AMMONIA (N) | 0.08 | 0.05 |
| TOTAL ORGANIC NITROGEN (N) | 0.26 | 0.34 |
| TOTAL PHOSPHORUS (P) | 0.013 | 0.013 |
| TOTAL ORTHOPHOSPHATE (P) | 0.004 | 0.003 |
| SPECIFIC CONDUCTANCE (MICROMHOS) | 58 | 57 |
| WATER TEMPERATURE (DEG C) | 20.6 | 20.3 |
| COLOR (PLATINUM-COBALT UNITS) | 20 | 20 |
| SECCHI-DISC VISIBILITY (FT) | 8 | |
| DISSOLVED OXYGEN | 6.9 | 6.5 |

| | |
|---|---|
| LAKE SHORELINE COVERED BY EMERSED PLANTS | 76-100 % |
| LAKE SURFACE COVERED BY EMERSED PLANTS | 1- 10 % |

| | |
|---|---|
| DATE | 9/ 5/74 |
| TIME | 1250 |
| NUMBER OF FECAL COLIFORM SAMPLES | 4 |
| FECAL COLIFORM, MINIMUM (COL./100ML) | <1 |
| FECAL COLIFORM, MAXIMUM (COL./100ML) | 5 |
| FECAL COLIFORM, MEAN (COL./100ML) | 2 |

REMARKS

AN ARTIFICIAL LAKE CREATED BY A DAM ON BIG BEEF CREEK. EMERSED PLANTS COVERED THE SHORELINE. SUBMERSED PLANTS WERE OBSERVED IN THE BAY AREAS AND AT THE SOUTH END OF THE LAKE.




William Symington Lake, Kitsap County.
From U.S. Geological Survey, February 22, 1974.


William Symington Lake, Kitsap County.
May 28, 1972. Approx. scale 1:12,000.

WYE LAKE KITSAP COUNTY

LATITUDE 47°25'22" LONGITUDE 122°45'27" T22N-R1W-2
PUGET SOUND BASIN

| PHYSICAL DATA | | CULTURAL DATA | |
|---|---|---|---|
| DRAINAGE AREA | 1.06 SQ MI | RESIDENTIAL DEVELOPMENT | 99 % |
| ALTITUDE | 300. FT | | |
| LAKE AREA | 39. ACRES | NUMBER OF NEARSHORE HOMES | 96 |
| LAKE VOLUME | 370. ACRE-FT | | |
| MEAN DEPTH | 10. FT | LAND USE IN DRAINAGE BASIN | |
| MAXIMUM DEPTH | 15. FT | | |
| SHORELINE LENGTH | 1.7 MI | RESIDENTIAL URBAN | 0 % |
| SHORELINE CONFIGURATION | 2.0 | RESIDENTIAL SUBURBAN | 20 % |
| DEVELOPMENT OF VOLUME | 0.64 | AGRICULTURAL | 0 % |
| BOTTOM SLOPE | 1.0 % | FOREST OR UNPRODUCTIVE | 74 % |
| BASIN GEOLOGY | SED./META. | LAKE SURFACE | 6 % |
| INFLOW | INTERMITTENT | | |
| OUTFLOW CHANNEL | PRESENT | PUBLIC BOAT ACCESS TO LAKE | YES |

WATER-QUALITY DATA (IN MG/L UNLESS OTHERWISE INDICATED)

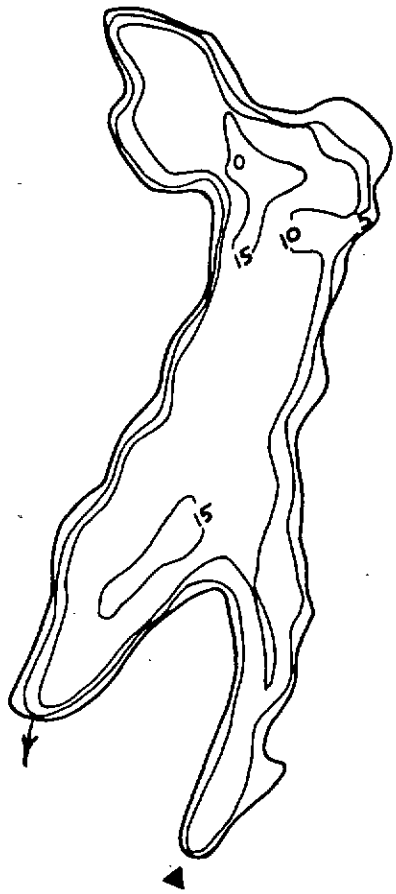
| SAMPLE SITE | 1 | |
|---|---|---|
| DATE | 6/29/72 | |
| TIME | 740 | 750 |
| DEPTH (FT) | 3. | 12. |
| TOTAL NITRATE (N) | 0.00 | 0.00 |
| TOTAL NITRITE (N) | 0.00 | 0.00 |
| TOTAL AMMONIA (N) | 0.02 | 0.00 |
| TOTAL ORGANIC NITROGEN (N) | 0.23 | 0.17 |
| TOTAL PHOSPHORUS (P) | 0.010 | 0.020 |
| TOTAL ORTHOPHOSPHATE (P) | 0.010 | 0.000 |
| SPECIFIC CONDUCTANCE (MICROMHOS) | 18 | 18 |
| WATER TEMPERATURE (DEG C) | 18.5 | 18.5 |
| COLOR (PLATINUM-COBALT UNITS) | 10 | 10 |
| SECCHI-DISC VISIBILITY (FT) | 14 | |
| DISSOLVED OXYGEN | 9.1 | 8.9 |

| | |
|---|---|
| LAKE SHORELINE COVERED BY EMERSED PLANTS | 1- 10 % |
| LAKE SURFACE COVERED BY EMERSED PLANTS | NONE OR <1 % |

| | |
|---|---|
| DATE | 6/29/72 |
| TIME | 800 |
| NUMBER OF FECAL COLIFORM SAMPLES | 4 |
| FECAL COLIFORM, MINIMUM (COL./100ML) | <1 |
| FECAL COLIFORM, MAXIMUM (COL./100ML) | 3 |
| FECAL COLIFORM, MEAN (COL./100ML) | 1 |

REMARKS

THE GRAVEL BOTTOM IN THE LITTORAL ZONE SUPPORTED A SPARSE GROWTH OF AQUATIC MACROPHYTES. IN 1972 THE U.S. GEOLOGICAL SURVEY SAMPLED THE LAKE FOUR TIMES. THE PLANT SURVEY WAS MADE ON OCTOBER 17, 1972.




N

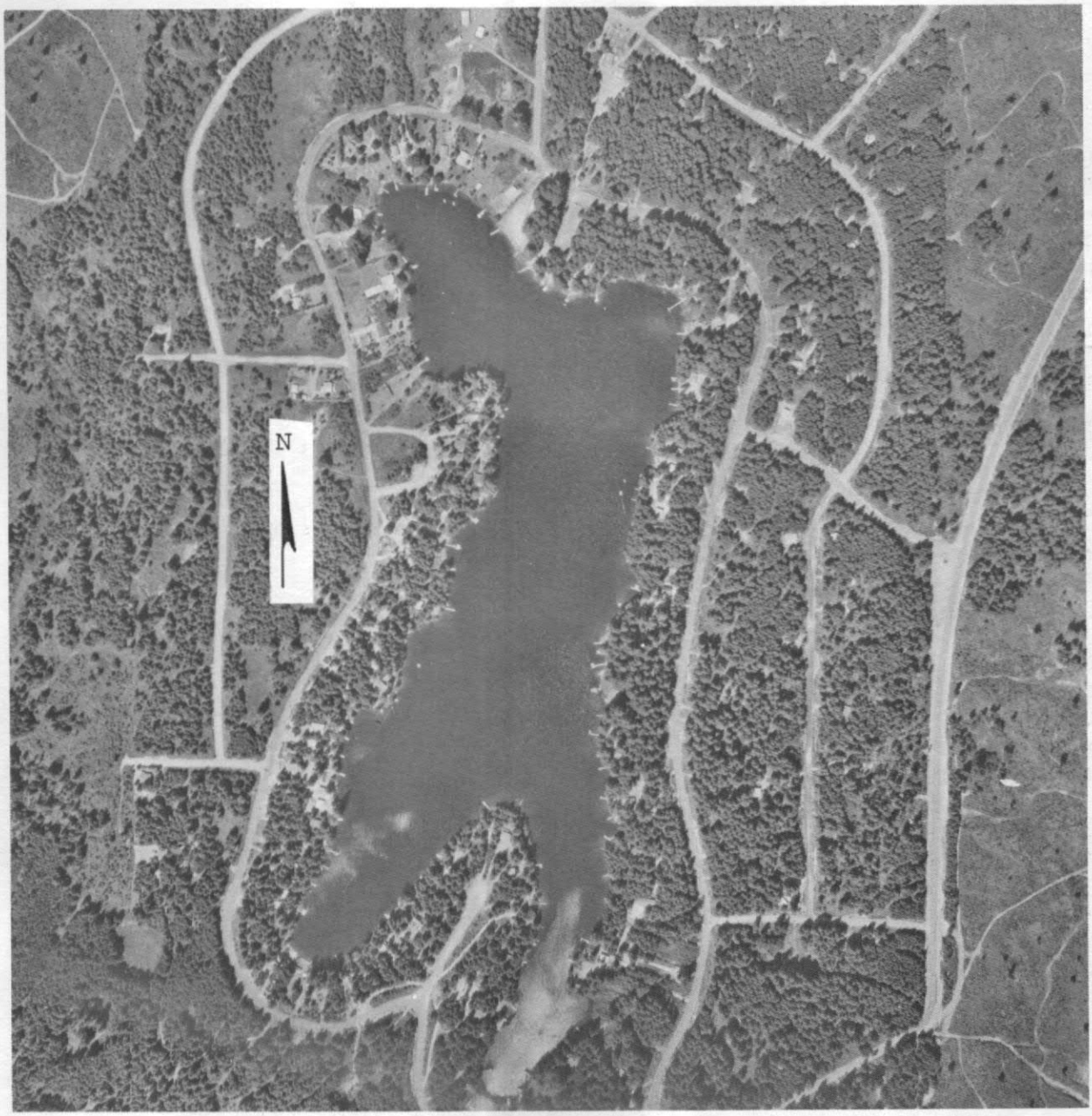
0 1000 2000 FEET

EXPLANATION

—10—

Line of equal
water depth
Interval 5 feet

Wye Lake, Kitsap County. From Washington Department of Game, June 4, 1949.




Wye Lake, Kitsap County. August 9, 1972. Approx. scale 1:6800.